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EUCALYPTOGRAPHIA.

A DESCRIPTIVE ATLAS

OF THE

EUCALYPTS OF AUSTRALIA

AND THE

ADJOINING ISLANDS;

BY

BARON FERD. VON MUELLER, K.C.M.G., M. & PH.D., F.R.S.,

GOVERNMENT BOTANIST FOR THE COLONY OF VICTORIA.

"NON SUCCIDES ARBORES, NEC SECURIBUS DEBES VASTARE EARUM REGIONEM."—*Liber Deuteronomii* xx. 19.

FIFTH DECADE.

MELBOURNE:

JOHN FERRES, GOVERNMENT PRINTER.

PUBLISHED ALSO BY GEORGE ROBERTSON, LITTLE COLLINS STREET.

LONDON:

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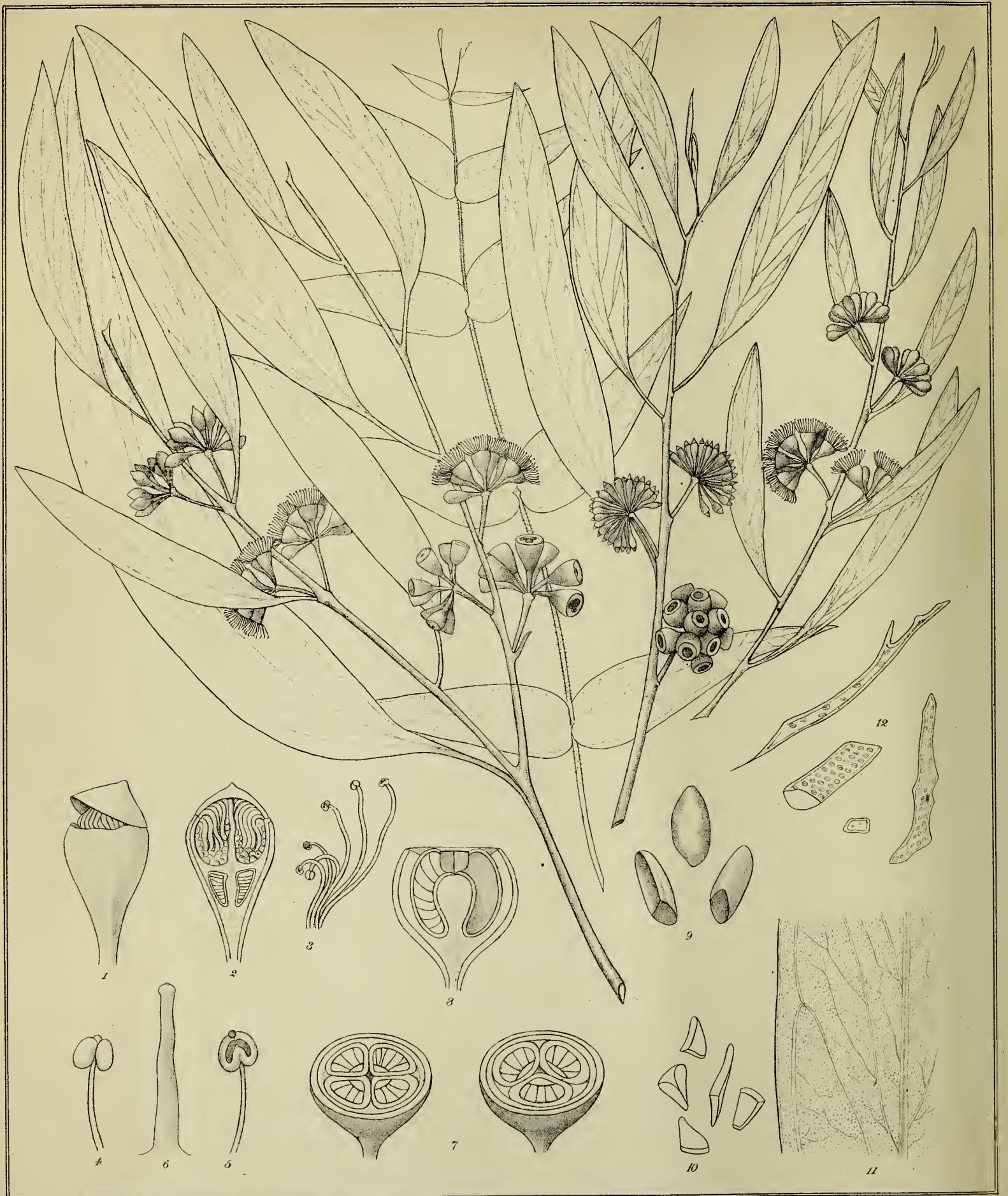
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Eucalyptus amygdalina. Labillardière.

EUCALYPTUS AMYGDALINA.

Labillardière, Novæ Hollandiæ plantarum specimen ii. 14, t. 154 (1806); Candolle, prodromus systematis naturalis regni vegetabilis iii. 219; Hooker, Botanical Magazine t. 3260; J. Hooker, flora Tasmanica, i. 35; F. v. M., fragmenta phytographiæ Australiæ ii. 53; Bentham, flora Australiensis iii. 202; *E. radiata*, Sieber, in Candolle prodromus systematis naturalis regni vegetabilis iii. 218; Candolle, mémoire sur la famille des myrtacées, t. 7; J. Hooker, flora Tasmanica i. 137; *E. elata*, Dehnhardt, catalogus plantarum horti Camaldulensis p. 26 (1829); *E. tenuiramis*, Miquel, in Nederlandisk Kruidekundig Archief iv. 128; *E. nitida*, J. Hooker, flora Tasmanica, i. 137, t. xxix.

The "Giant-Eucalypt" or "Wangara." Finally very tall; branchlets slender; leaves on rather short stalks, scattered or rarely opposite, narrow- or sickleshaped-lanceolar or very narrow, usually attenuated into an acute but oblique base, generally not of thick consistence, mostly of a saturated green and somewhat shining on both sides; *lateral veins very thin, not much spreading*, nor closely approximated, the circumferential vein remote from the edge of the leaf; *oil-dots very copious, transparent*; umbels with few or oftener several or many flowers, solitary, axillary, on slender almost cylindrical or slightly angular sometimes very short stalks; calyces small, attenuated into a short thin stalklet, not angular; tube obconical, upwards dilated, usually twice as long as the hemispheric blunt or short-pointed lid; stamens very short, all fertile, inflexed before expansion; *anthers very small, nearly kidneyshaped*, opening with divergent slits; stigma hardly broader than the style; ripe fruits small, semiovate or sometimes verging towards a truncate-globular form, 3- to 4- or rarely 5-celled, the rim finally flat and usually rather broad; valves tender, convergent, deltoid, close to the orifice, slightly or not exserted; fertile as well as sterile seeds quite small, all without appendage.

From the southern and the whole eastern humid districts of the colony of Victoria extending to the base of the Alps, to the Blue Mountains and the litoral slopes of New South Wales, not far advancing on the western fall of the country, frequent in Tasmania, ascending to about 4,000 feet elevation.

This Eucalyptus is one of the most remarkable and important of all plants in the whole creation! Viewed in its marvellous height when standing forth in its fullest development on the slopes or within glens of mountain-forests, it represents probably the *tallest of all trees of the globe*; considered as a hardwood-tree of celerity in growth it ranks among the very foremost; regarded in reference to its timber the tall variety can fairly be classed with the superior kinds of Eucalypts, and contemplated in respect to the yield of volatile oil from its copious foliage it is unsurpassed and perhaps not equalled by any other tree in the whole world! These various signal qualities of *E. amygdalina* having become gradually known, much through the exertions of the writer, this tree has found already a wide appreciation abroad, in countries neither subject to severe frosts nor to intense moist heat. It assumes under different climatic and geologic conditions various forms; thus in the irrigated ravines of cooler ranges the tree attains the most towering height, combined with a perfect straightness of stem, while the outer layers of its bark decorticate so completely as to render the huge stems quite smooth and almost white, the habit then being that of its only rival in loftiness among congeners, namely *E. diversicolor* (the Karri of West Australia). This lofty state of the tree passes as one of the White Gum-trees (and even also as Mountain-Ash in the Dandenong-Ranges), while phytographically it has been distinguished as "regnans." According to Mr. F. Abbott it is this form, which constitutes the "Swamp Gum-tree" in Tasmania, where already Sir William Denison placed early its huge dimensions on record. In more open and in merely ridgy country *E. amygdalina* remains much lower in stature, even

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often a comparatively dwarf tree, with outside rough, inside tough somewhat fibrous bark, which remains more or less persistent on the stem and even lower branches ; under such conditions the species is called a "Peppermint-tree" in Victoria and Tasmania and a "Messmate-tree" in some tracts of New South Wales. (*Vide* Woolls, Lectures on the Vegetable Kingdom, p. 121.)

The bark, when it persists, is however much more solid than that of *E. macrorrhyncha* and *E. obliqua*, offering a transit of the *Pachyphloia* to *Rhytiphloia*. On account of the toughness of the inner bark the natives of Gippsland have given to this tree the name of "Wangara," meaning literally translated "Bark strong" (Howitt). The stems of young seedlings or of sprouts from stumps are thin, somewhat warty- or glandular-rough, not angular ; their leaves are opposite, sessile, narrow oblong- or oval-lanceolar, rounded or cordate at the base or even connate as in *E. uncinata*, paler beneath and sometimes covered with whitish bloom. The leaves of the aged tree from cold exposed localities are thicker (as is the case also with *E. Gunnii*), and then the oil-glands are much obscured. Flowering and fruiting branches present only under exceptional circumstances opposite leaves. As many as 43 flowers have been counted by me in one umbel. Instances occur, in which the lid is acutely pointed. The fruit is occasionally shortened to an almost hemispheric form and its valves may occur increased even to six ; the rim sometimes descends rather abruptly to the valves, rendering then the edge of the orifice narrow.

The systematic name, given by Mons. Labillardière to this tree, is not happily chosen, as it neither in habit nor in foliage nor in any other way bears resemblance to the Almond-tree. His work illustrates the narrow-leaved variety. To the synonyms are added by Benth *E. longifolia* (Lindley, Botanical Register 947) and hence *E. Lindleyana* (Candolle, prodromus iii. 219), although the drawing affords no positive evidence of the species intended. Benth refers here doubtfully also *E. ambigua* (Candolle, prodromus iii. 219), which however may be a West Australian species, the somewhat leathery leaves, the compressed flowerstalks and the almost globular fruit not really pointing to *E. amygdalina* ; but *E. linearis* (Dehnhardt, Rivista Napolitana i. 3, p. 173 anno 1839) seems merely to indicate a variety, remarkable for the extraordinary narrowness of its leaves, but neither flowers nor fruits occur in the authentic specimen, preserved in the collection of Baron Cesati, who kindly placed samples of Dehnhardt's original plants at my disposal.

Eucalyptus Risdoni (J. Hooker, in the London Journal of Botany vi. 477 ; flora Tasmanica i. 133, t. 24 ; Benth, flora Australiensis iii. 203) seems an aberrant form only of *E. amygdalina*, as pointed out by me already in 1860 ; and the same may be said of *E. dives* (Schauer, in Walpers repertorium botanices systematicæ ii. 926 ; Benth, flora Australiensis iii. 205) ; but the local circumstances, under which these seemingly aberrative states arose, remain hitherto uninvestigated. *E. Risdoni* is as yet only known from Southern Tasmania ; it is a small tree ; the leaves of the upper branches are mostly, like those of the variety *nitida* (*E. nitida*, J. Hooker), thick and rigid, comparatively short and almost equilateral, while the leaves of the lower branches are, like those of seedlings and sprouts, opposite, sessile, broad, often connate and as well as the branchlets and umbels chalky-whitish, moreover the fruits are generally larger ; but these characteristics are of degree only and none positively specific ; it would seem also as if analogous cases were presented by *E. Stuartiana* and *E. crebra*, inasmuch as *E. cinerea* and *E. melanophloia* appear to hold the same position to *E. Stuartiana* and *E. crebra* as *E. Risdoni* to *E. amygdalina*. The distinctions of *E. dives* are equally weak, being reduced to the suppression or extreme shortness of the leafstalks, and to opposite thick ovate- or broad-lanceolar leaves, but it is wanting altogether in the chalky

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but also variable coloration of *E. Risdoni* ; it is now also known from the sources of the Loddon and Shoalhaven-River. The unreliability of the cortical characteristics of *E. amygdalina* render it sometimes difficult to distinguish this species from *E. Sieberiana*, especially in the absence of flowers ; but that portion of the bark, which long persists, is not deeply furrowed, the wood is more fissile, the leaves are more copiously dotted, the flowerstalks are not strongly compressed, none of the stamens are sterile, and the fruit is less elongated. It differs from *E. hæmastoma* in the veins of the leaves less spreading and less prominent, in thinner almost cylindric flowerstalks and all the filaments provided with anthers, also in comparatively shorter fruit. The thick-leaved varieties of *E. amygdalina* approach in many respects *E. coccifera*, but the lid of the calyx is not remarkably depressed even in the Risdonian variety, with which this shares the chalky bloom, the tube of the calyx of the genuine *E. amygdalina* is never so long and not angular, the flowerstalks are not so stout nor so flattened and the stalklets more slender. That form of *E. amygdalina*, which produces fruits more contracted at the orifice, bears so far much resemblance to *E. piperita*, but the bark is less persistent and less stringy, the veins of the leaves are not so spreading, the lid is never conical, the stalklets are generally longer and the fruits as a rule smaller. All the other species of the section *Renantheræ* are more distinct.

The number and distribution of the stomata are in this species subject to unusual variability, explainable by the age of the tree and the open or shady position of its growth.

This tree has a preference for the silurian formation and particularly for metamorphic schist, as first traced by Mr. Howitt, at least in our uplands.

E. amygdalina is one of the hardier of its congeners, and if *E. coccifera* constitutes an alpine state of it, then it has in that remarkable form braved even unusually cold winters of Britain. For instance at Powderham-Castle, the seat of the Earl of Devon, it passed unscathed through an ordeal of $+ 9^{\circ}$ of Fahrenheit's scale while *E. globulus* was destroyed already at $+ 20^{\circ}$ F. The above noted severe cold caused to *E. coccifera* no injury whatever, so that perhaps that tree will withstand a still somewhat lower temperature ; it produced in the subsequent summer thousands of sprays of blossoms. Its height at Powderham-Castle was 58 feet, the stem measuring at $3\frac{1}{2}$ feet from the ground $7\frac{1}{2}$ feet in circumference ; it grows there on sandy loam of rising ground. (Powell, in the Gardener's Chronicle 1879, p. 113, with xylographic illustration.)

It is the intention to give on a future occasion a schedule of exact measurements, clinometrically obtained, of the tallest individual trees anywhere to be found ; but it may for the present suffice to observe, that approximate heights for this tree of 400 feet have been obtained by the writer at the Black Spur and elsewhere on the Upper Yarra and Upper Goulburn-River. Mr. D. Boyle first of all ascertained the length of a fallen tree of this species, found by him in the Dandenong-Ranges, at 420 feet ; the length of the stem up to the first branch being 295 feet, the diameter of the stem at the commencement of the ramification proved 4 feet, 70 feet higher up the diameter was still 3 feet, the top-portion was wanting. A still thicker tree there measured at 3 feet from the ground 53 feet in circumference. Mr. Boyle found another tree with a stem 25 feet in diameter at the base, yet the bark quite thin. Mr. Howitt obtained in Gippsland also measurements up to 410 feet. The Rev. Th. Ewing (as stated in Henfrey's Botanic Gazette) measured a prostrate tree on a rill of the North-West Bay River at the rear of Mount Wellington already thirty years ago and recorded the height up to the first branch 220 feet, from thence to where the top was broken off 64 feet more ; the basal diameter proved to be 30 feet, the stem-diameter at 220 feet was still 12 feet ! and to that distance it would turn out already more timber than three

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of the largest oaks taken together with their branches. A standing tree at the same place measured 3 feet from the ground 102 feet in circumference, but close to the ground even 130 feet ! The rev. gentleman observed within a square mile at least 100 trees, none less than 40 feet in circumference at the base (Dr. Masters). Mr. G. Robinson noticed in the back-ranges of Berwick the circumference of a stem to be even 81 feet at a distance of 4 feet from the ground. (*See* Ellwood Cooper's edition of some of my lectures and essays, p. 161). The same gentleman, whose professional judgment as a surveyor would give every guarantee for accuracy, obtained at the foot of Mount Baw Baw the measurement of an exceptionally large tree, which was 471 feet high. From the Cape Otway-Ranges a tree is also on record by Mr. Walter, with a height of 415 feet and a basal diameter of 15 feet, although the loftiest trees have not always the most colossal stems. But though this Eucalypt of ours will probably maintain the actual supremacy in height among trees of the globe, it must cede the palm of superiority perhaps to the Wellingtonia-Sequoia and the only other congener of the Mammoth-tree of California in respect to height combined with massive ramification and a crown of foliage dense to the summit in Sequoias—because the final extraordinary height of *E. amygdalina* is often attained only by a solitary straggling branch, pushing singly towards the sky. It is a grand picture to see a mass of enormously tall trees of this kind with stems of mast-like straightness and clear whiteness so close together in the forest as to allow them space only towards their summit to send their scanty branches and sparse foliage to the free light.

The timber is useful for many kinds of carpenters' work ; in drying it does not twist ; when straight stems are produced in forest-valleys the wood splits better into palings than even that of our Stringybark-tree, and this with such facility, that in some particular instance a laborer has split 620 palings of 5 feet length in one day ; the timber is comparatively not heavy, as it floats in water, unlike that of many other Eucalypts ; it is particularly well adapted for shingles, palings and rails and also drawn into use for shipbuilding, especially kelsons and planking (*see* F. v. M., *Select Plants*, Indian edition p. 107), but it has not been found very lasting underground and does not afford a superior fuel ; indeed the stems, when fallen, perish more quickly than those of many other Eucalypts, and thus the records of individual trees of marvellous height, when measured lying on the ground, are often early lost.

The utmost praise is due to Joseph Bosisto, Esq., M.L.A., J.P., for his lengthened and extensive researches on the oil of this and other congeners, to the technical production, local utilisation and mercantile export of which he has given large dimensions by his enterprise and perseverance, it having fallen to the writer's share to draw in first instance attention to the enormous yield of oil from the foliage of *E. amygdalina*. Mr. Bosisto sums up his experience with the Eucalyptus-oils, as regards the percentage of the yield of the various species, on which he experimented, in the following schedule :—

From 1,000 lbs. of fresh leaves with their stalklets and branchlets—

<i>Eucalyptus viminalis</i> yields	7 ounces	<i>Eucalyptus goniocalyx</i> yields	150 ounces
<i>melliodora</i> yields	7 „	<i>Leucoxylon</i> yields	160 „
<i>rostrata</i> yields	15 „	<i>oleosa</i> (mixed with other species	
<i>obliqua</i> yields	80 „	of the Mallee-scrub) yields	200 „
<i>globulus</i> yields	120 „	<i>amygdalina</i> yields	500 „

But this average-yield, thus demonstrated by Mr. Bosisto to rise to more than 3 per cent. in *E. amygdalina*, fluctuates during the various seasons, it being during the cool months of the year

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appreciably less than during the summer. The distilled oil from the foliage of *E. amygdalina* is pale-yellow, thin, of rather pungent Cajuput-like odor, of cooling afterwards bitter taste, of 0.881 specific gravity, boils at from 329 to 370° F., deposits stearopten at low temperatures. Mr. J. W. Osborne, who at the instance of the author subjected various Eucalyptus-oils to extensive tests for the second London Exhibition, found the diminishing degree of solubility of the following substances to be in the subsequent order: Camphor, Pine-resins, Mastic, Sandarac, Elemi, Kauri, Asphalt, Xanthorrhœa-resin, Benzoe, Copal, Amber, Anime, Shellac, Caoutchouc, Beeswax. (*See Jurors' Report of the Exhibition of 1863.*) Eucalyptus-oil dissolves also Gutta-Percha readily, and can be used in lamps like Petroleum, with this important advantage, that it has greater illuminating power, has a rather pleasant odor and is not liable to cause explosions, though it remains a much more costly article. Eucalyptus-leaves found however during the earlier period of our colony for years use in one of our towns for the production of light-gas. Mr. Bosisto obtained 10 per cent. of pearlash from the ashes of the foliage of *E. amygdalina*.

Eucalyptol, first obtained by Cloëz in Paris, through repeated fractional distillation, presents according to him the chemical formula $C^{24} H^{20} O^2$; it is a very mobile colorless liquid, boiling at 347° F., of 0.905 specific gravity. It rotates polarized light to the right, remains liquid at low temperatures, is little soluble in water, completely in alcohol, the solution being of somewhat rosy odor when much diluted; Eucalyptol forms when distilled with anhydrous phosphoric acid Eucalypten = $C^{24} H^{18}$, a liquid boiling at 329° F. and of 0.836 specific gravity. (*Compt. Rend. lxx. 678.*) But Eucalyptol, according to Drs. Homeyer and A. Faust, is composed of a terpene and cymene (both hydrocarbons) and eucalyptol; the proportions of these in various Eucalyptus-oils is not the same.

The capacity of the stills in Mr. Bosisto's factory in Western Gippsland amounts at present approximately to 2,000 gallons, the produce of oil being about 12,000 lbs. annually now; as much as 6 tons of leaves are operated on daily. These extensive operations have reduced the product to a remarkable cheapness, so much so that the wholesale-price in Victoria has sunk to 2s. 6d. per lb., while in the English market it is only 3s. Eucalyptus-oil, irrespective of its great therapeutic value, is much used for additions to perfumery (dilution of the oils of roses, orange-flowers &c.) and for select varnishes and various other technic applications. Several other species yield volatile oil also very copiously, for instance *E. salubris*, *E. salmonophloia*, *E. longicornis*, *E. microcorys* (*see F. v. M., Report on the Forest-Resources of Western Australia, pp. 12-15, pl. xii., xiii., xiv.*), but most of them being smaller trees, would not afford an equal bulk of foliage. When the stems of the dwarf variety are cut, new shoots spring from the root, thus a fresh crop of foliage is furnished in a few years. Sir William Dehison, G.C.M.G., Sir Robert Officer and Dr. Motherwell instituted in Tasmania about thirty years ago some experiments for the distillation of Eucalyptus-oil; but these observations were not followed up there by any practical applications in factories; but in that island pyrolignous acid was produced from Eucalyptus wood on a large scale for some years, but this operation was discontinued, perhaps because the other products of dry distillation such as tar, pitch and wood-alcohol could not be sufficiently utilized at the time.

The hygienic properties of Eucalypts, largely dependent on the volatile oil of their foliage, have been discussed in many essays, one on this subject by our fellow-colonist Mr. Bosisto being among the foremost. (*See Proceedings of the Royal Society of Victoria, August 1874.*)

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Mons. P. Ramel, Mons. A. Thozet, the writer and many others have early drawn public attention to the importance of these trees for subduing malaria, after incidentally the febrifugal properties of the Eucalypts had been discovered first by Spanish physicians in 1866 and been confirmed soon subsequently by medical men in France and Italy, to whom the opportunities for hygienic researches of this kind much more readily arose than to us here, in places where periodically or even continuously malarian fevers were raging, and where these, so soon as Eucalyptus-vegetation copiously arose (and this often through the instrumentality of the writer) the disease was suddenly or gradually checked, mostly even without recurrence. The powerful disinfecting action of the oily volatile emanations of the Eucalypts are mainly due to the evolution of Ozone and double oxyd of Hydrogen, as shown by experiments of Dr. Andrews and Dr. G. Day. But irrespective of this the power of also this Eucalypt to absorb moisture from the ground is enormous and of vast hygienic significance, and stands in proportion to the intensity of the aqueous exhalation, in which latter respect many Eucalypts vastly surpass Elms, Oaks, Poplars and many other trees. (*See my lecture on "Forest-culture in relation to Industrial Pursuits" &c., Ellwood Cooper's edition p. 99.*) The gradually dropping foliage, unlike that of most other trees, acts also deodorizing on the soil. Sir Will. Macarthur alluded likewise early to the healthiness of Eucalyptus-regions.

Again quite recently Prince Pierre Troubetzkoy once more insisted, as was done by us here many years ago, that to *E. amygdalina* preference should be given over any other congener for plantations in any paludal fever-regions, wherever climatic circumstances would allow it to prosper, although this species grows not with quite the rapidity of *E. globulus*, nor accommodates itself with the same facility to a great diversity of soils. At Lago Maggiore, where Prince Troubetzkoy instituted his observations, *E. amygdalina* grew 60 feet in nine years, and endured a temperature sinking occasionally as low as 18° F., proving hardier than *E. globulus* and *E. rostrata*. *See Bulletin de la Société d'Acclimatation, Paris, 1879, pp. 338-342*, in which important journal the culture of Eucalyptus has been strenuously advocated by M. Ramel and numerous other writers ever since 1858. *See also Count Luigi Torelli's Memoir "l'Eucalyptus e Roma" 1879, pp. 48-49.*

Dr. Josef Moeller of Vienna describes the wood of *E. amygdalina* anatomically in nearly the following words (translated):—The vascular tubes are always isolated and irregularly scattered in scanty number; their lumen exceeds rarely 0.06 mm.; their walls are but slightly thickened and are seriated-dotted; parenchyma is only scantily developed; the woody fibres are also dotted, at an average 0.012 mm. broad, of which two-thirds pertain to the lumen; their contours are uneven; the medullary rays consist of one or two rows of cells, not rarely cubical and rather broad about 0.024 mm.

The form of the expanded cotyledonar leaves is characteristic to some extent for various Eucalypts; in *E. amygdalina* they are ovate-kidneyshaped and tapering into short stalklets, whereas some other species, for instance *E. cornuta*, have them deeply cleft into two narrow divergent lobes.

EXPLANATION OF ANALYTIC DETAILS.—1, unexpanded flower, the lid partly lifted; 2, longitudinal section of an unexpanded flower; 3, some stamens in situ; 4-5, back- and front-view of a stamen with part of its filament; 6, style and stigma; 7 and 8, transverse and longitudinal section of fruits; 9 and 10, fertile and sterile seeds; 11, portion of a leaf; 12, vascular, prosenchymatous and parenchymatous elements of wood; all magnified to various extent, fig. 12 as much as 220 times diametrically.



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Eucalyptus Corymbosa. Smith.

EUCALYPTUS CORYMBOSA.

Smith, a specimen of the Botany of New Holland 43 (1793); Transactions of the Linnean Society iii. 287; Cavanilles, icones et descriptiones plantarum t. 340; De Candolle, prodromus systematis naturalis regni vegetabilis iii. 220; F. v. M., fragmenta phytographiæ Australiæ ii. 46; Bentham, flora Australiensis iii. 256; *Metrosideros gummifera*, Solander, in Gärtner de fructibus et seminibus i. 170, tab. 34, fig. 1.

The ordinary Bloodwood-tree.

Finally tall; *leaves* scattered, of firm consistence, ovate- or elongate-lanceolar, slightly curved or somewhat sickleshaped, *paler beneath, the lateral veins very numerous, subtle, almost transversely spreading*, the circumferential vein nearly contiguous to the edge; the oil-dots generally concealed or obliterated; *umbels paniculated*, mostly terminal, rarely solitary and axillary, on slender slightly compressed or angular stalks, bearing from 3 to 9 rather large flowers; stalklets from somewhat shorter to considerably longer than the calyx, angular, rather slender; *lid depressed-hemispherical*, short-pointed, *tearing off along a rather irregular transverse line*, exceeded in width and much in length by the obconic-bellshaped tube of the calyx; stamens all fertile, inflexed before expansion; filaments yellowish-white; anthers oblong-oval, blunt, opening by longitudinal parallel slits; ovary flat-topped; stigma hardly broader than the summit of the style; *fruit large, oval-urnshaped*, not angular, 3- or oftener 4-celled; rim narrow; *valves deeply enclosed, deltoid; fertile seeds large, provided with a narrow or short appendicular membrane*, sterile seeds much smaller.

From the vicinity of the Genoa-River to near Rockingham-Bay on dry ridges and hills or in open forest-ground, ascending to considerable mountain-elevations in New England.

A tree, attaining a maximum-height of 150 feet, but often of much lower and sometimes stunted growth, fruiting already when hardly advanced beyond its early shrubby state. *Bark persistent, outside rough*, wrinkled, grey and turning somewhat black, inside yellowish- or reddish-brown; that of the upper branches smooth and often reddish; but in New England it seems to be noticed, that the bark also becomes smooth and whitish from shelving off in flakes. Branchlets not very angular. Panicles more or less ample, of pleasant scent. Calyces generally dark-colored; the rim of their tube soon after flowering somewhat revolute. Lid not dehiscent along a sharply defined suture, often continuing to adhere to the rim unilaterally for some time. Filaments not so fine-capillary as in many other species. Anthers dorsifixed. Fruits not generally polished-smooth, but of a dull color outside; the valves sometimes remaining coherent and then seceding as a circular disk. Seeds rather few in each cell.

The wood is easily enough worked when fresh, but becomes very hard when dry; it is long-lasting underground and according to Mr. S. Johnson it is as resistant to the Termites as the wood of several Ironbark-trees, but it is intersected by concentric fissures, filled with fluid or indurated Kino-secretions, whence the popular name of this tree is derived; but for the same reason the timber is not available for sawing purposes, and it does not turn out a good fuel, as it is difficult to burn. The Kino-sap indurates soon on its own accord, as in all congeners, and is gathered for therapeutic or industrial purposes as exuded spontaneously from the stem and bark, in its dry state without any preparation, liquid Kino becoming merely exceptionally mercantile and then also only as a crude product. This seems not generally known abroad, nor the fact, that the mere general name "Gum-tree" for Eucalypts does not indicate even the least supply of Kino for commercial purposes. (*See* Wiesner, die Rohstoffe des Pflanzenreiches p. 188.)

The species, as far as here noticed, is restricted to the ordinary state, in which it appears through the more litoral regions of New South Wales and Southern Queensland. But the greatest

EUCALYPTUS CORYMBOSA.

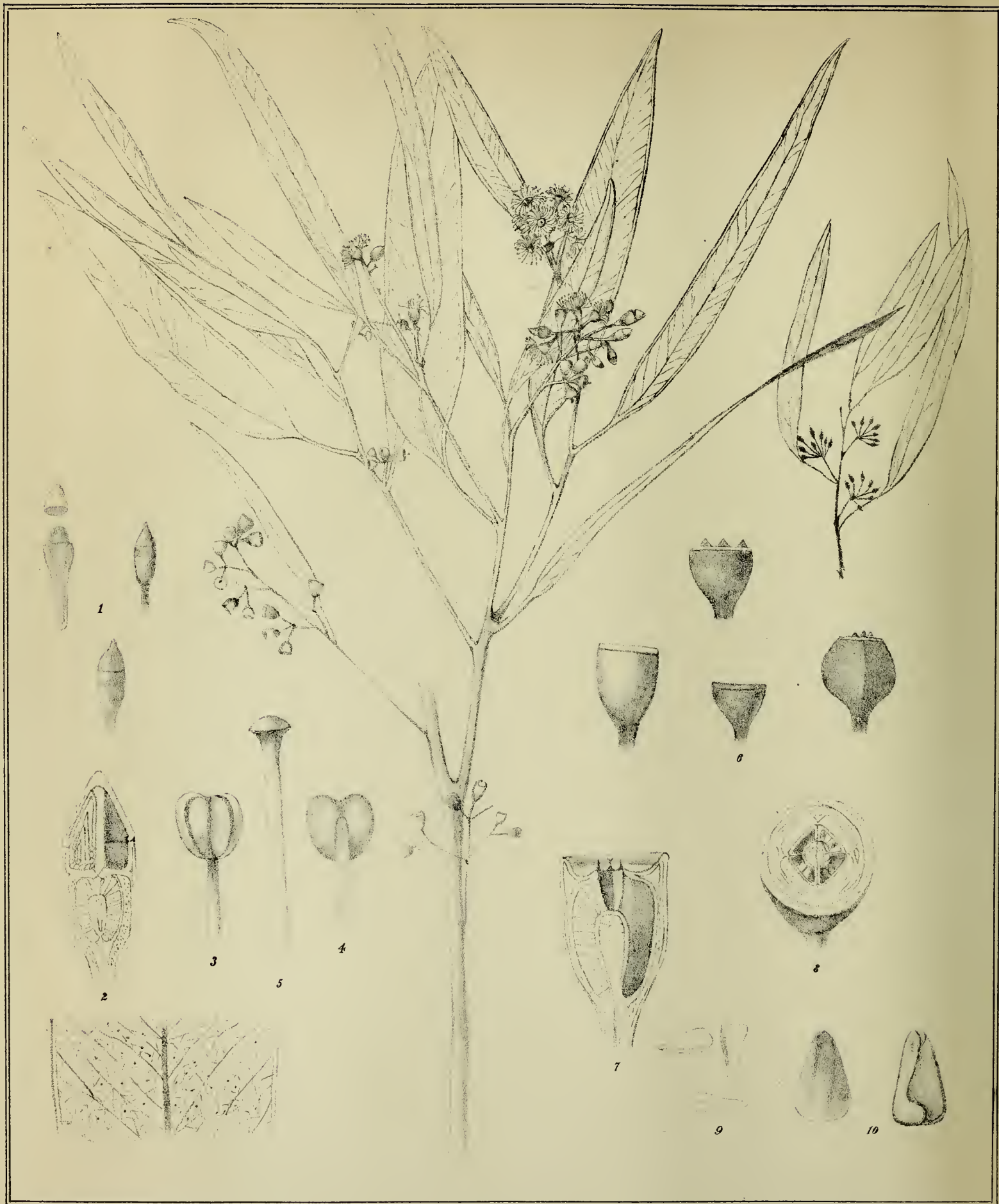
embarrassment has arisen in specifying the limits, by which *E. terminalis* (*E. pyrophora*, Benth., flora Australiensis iii. 257) may constantly be separated; thus Benth. already was inclined to consider both as forms only of *E. corymbosa*, a view which the accumulation of much additional material has almost confirmed. In the wide tracts of intratropical Australia *E. terminalis* with its varieties occurs even far inland, thus at the Barcoo (Dr. Wuth) and at Lady Charlotte's Water (*E. Giles*) in such hot and arid regions, as are climatically vastly different from the cool forest-ravines of the south-east coast; hence gradually the leaves become paler, nearly or fully as much on the upper surface as beneath, their position gets more vertical and therewith stomata occur also on the upper page, the panicles also assume often a paler hue, the flowers and fruits generally are smaller, the latter become less woody and somewhat more slender, and often lose the outward curvature towards the rim; but the fertile seeds of *E. terminalis* are as a rule provided with a terminal membranous appendage of about the length of the kernel, a characteristic hardly ever occurring in the typical *E. corymbosa*. An extraordinary variability is also evinced by *E. terminalis* as regards not only the size of its calyx, but also the manner of its dehiscence, a regular sutural line being sometimes not traceable, necessitating an irregular defraction of the opercular summit; the lid moreover verges sometimes to a flattened form with an almost obliterated apex, or the lid may be quite turgid and its apex very prominent.

E. dichromophloia has the fruits considerably smaller, about the size of those of *E. trachyphloia* and *E. latifolia*, besides the bark seems always different, as the specific name implies, from that of *E. corymbosa* and *E. terminalis*, its upper thin smooth and pale stratum separating from the brownish-red thick layers below. *E. latifolia* has very broad even roundish leaves, and belongs on account of its smooth bark to the section *Leiophloia*, unless this be subject to exceptions. *E. Abergiana* can be separated from *E. calophylla* and *E. terminalis* by the want of stalklets of its calyces and from the latter besides by the broader and above dark-green leaves. *E. calophylla* may be said to replace *E. corymbosa* in West-Australia, though *E. terminalis* advances to Nichol-Bay on the west-coast and perhaps still further southward. *E. calophylla* is however specifically different in several important respects. (*See F. v. M.*, report on the Forest-resources of Western Australia p. 4, pl. 2.) The young seedlings of all allied species require yet further comparison.

E. urnigera, which bears in its fruit considerable resemblance to *E. corymbosa*, differs essentially in having the leaves dark-green and somewhat shining on both sides, the latter moreover are provided with less spreading rather irregular and more distant lateral veins, a removed marginal vein and isogenous stomata, many of the flowerstalks are axillary and bear mostly 3 or occasionally only 2 flowers, the tube of the calyx is more cylindrical turgid below the middle and strongly constricted towards the rim, the lid is ampler than the orifice and seceding by a clear circumcission, the fruit is generally smaller, with more spreading rim, and the seeds are devoid of any appendage. It is moreover never a large tree and restricted to the subalpine zone of Southern Tasmania.

The Very Rev. Canon King noticed Melitose-Manna to a small extent on the leaves of *E. corymbosa*, when pierced by a phyllophagous Beetle (*Anoplognathus cereus*).

EXPLANATION OF ANALYTIC DETAILS.—1, upper part of an unexpanded flower, the lid lifted; 2, longitudinal section of an unexpanded flower; 3 and 4, front- and back-view of an anther with portion of its filament; 5, style and stigma; 6, stamens in situ; 7 and 8, longitudinal and transverse section of a fruit; 9 and 10, sterile and fertile seeds, one of the latter cut transversely; 11, portion of a leaf; all magnified, but to various extent.



R. Austen del. C. Troedel & Co. Lith.

F. v. M. direxit.

Steam Litho. Gov. Printing Office Melb.

Eucalyptus crebra. F. v. M.

EUCALYPTUS CREBRA.

F. v. M., in the Journal of the Linnean Society iii. 87 (1858); Bentham, flora Australiensis iii. 221.

Finally tall; leaves scattered, on rather short stalks, elongate- or falcate-lanceolar, sometimes very narrow, of somewhat thin consistence, of equal and dull green on both sides; *lateral veins subtle*, rather numerous, almost parallel and moderately spreading, the circumferential vein very near to the edge; oil-dots much concealed; *umbels paniculated* or some axillary and solitary, on slender stalks, with usually from 3 to 7 small flowers on rather short and thin stalklets; tube of the calyx nearly semiovate, about twice as long as the pyramidal- or hemispheric-conical lili or sometimes not much longer; stamens all fertile, inflexed in bud; *anthers very minute, roundish, opening by ample longitudinal slits*; stigma broader than the short style; fruits very small, semi-ovate, 4- less often 3-celled, their rim rather narrow, the valves deltoid, affixed close below the summit, quite enclosed or provided with slightly exerted points; seeds all without any appendage, the sterile considerably smaller than the fertile seeds and mostly broadish.

From near the southern shores of the Gulf of Carpentaria (F. v. M.) through the more littoral and hilly tracts of Eastern Australia to New England and further southward to the vicinity of Port Jackson and the Blue Mountains, westward to Darling-Downs (W. Hill), chiefly on scrubby ridges and ranges.

A tree, attaining a height of about 100 feet, with a stem-diameter of 3 feet, content with poor soil, known as red or narrow-leaved Ironbark-tree through the wide tracts of its occurrence. *Bark dark, persistent* on stem and branches, almost blackish, ridged and deeply furrowed, solid; but in exceptional geologic situations or perhaps under unusual climatic circumstances the bark occurs also smooth and whitish from decortication in laminar outer strips; still it is far less variable in this respect than *E. Leucoxylon*; however Mr. Walter Hill sends branchlets of a "Grey Gum-tree" with a note of its being smooth-barked throughout, which cannot be distinguished otherwise from *E. crebra*. Trunk branching far down or in other cases only ramified towards the summit of the tree. Timber reddish, regarded of superior value, all kinds of Ironbark-trees furnishing tough, elastic, hard and durable wood, locally much in use for fence-posts, railway-crossties, bridge-material, piles, for waggon-building and numerous other technic purposes. Major-General Sir E. Ward, K.C.M.G., found the specific gravity of this wood to be 1.19, and that a piece of 4 feet length and of 2 inches square breadth, when supported on its ends, would bear a weight of 1,792 lbs. before breaking. Mr. F. Byerley found the transverse strain to be able to sustain 710 lbs. when applied to the middle of a quartering of 1 inch thickness and of 1 foot length; thus the wood would not be as strong as that of *E. siderophloia* and *E. maculata*.

E. crebra is often gregarious, even so much so in some localities as to constitute the main-bulk of the forests, as is the case in Victoria, Tasmania and South-Australia chiefly with *E. obliqua* and in West Australia with *E. marginata* and *E. calophylla*. The copious occurrence of this tree through a large extent of East-Australia suggested the specific name.

Branchlets very slender and drooping. Oil-pores, particularly in young leaves, occasionally very pellucid. Filaments almost white, their lower portion very flexuous in bud. Fruit slightly attenuated at the base or gradually. The flowering time of this tree is known to fluctuate from March till October according to the geographic latitude of its range and to peculiarities of the climatic regions and seasons. Fruitbearing twigs of an Ironbark-tree with lemon-scented foliage were obtained by Mr. Bailey on the Palmer-River; these seem referable to *E. crebra* also, although the leaves are shorter and blunter and the peripheric vein is slightly removed from the

EUCALYPTUS CREBRA.

edge ; the fragrance of this supposed variety, which might be called *citrata*, is so exquisite, that the leaves can be used as a culinary condiment.

E. crebra might be mistaken for *E. largiflorens*, not easily in nature, but readily when dried sprigs with imperfect flowers or fruits are to be named ; the latter species recedes by its paler, less furrowed bark, the leaves more conspicuously and darker dotted, the lateral veins less copious, the circumferential vein much more removed from the edge, the anther-cells opening through a pore-like aperture and the lid perhaps generally shorter and blunter.

In rare instances some of the leaves may widen to a broadish form and become opposite, whereby a transit is established to *E. melanophloia* (the Silverleaved Ironbark-tree), unless indeed the latter is assumed to be the opposite- and sessile-leaved state of *E. crebra*, analogous to the position held by *E. amygdalina* and *E. Stuartiana* to *E. Risdoni* and *E. cinerea*. *E. melanophloia* again is very closely related to *E. pruinosa*, though differing already in blackish bark ; from *E. crebra* it is generally differing irrespective of its foliage in longer lid, in fruits somewhat larger and contracted at the orifice and always in the opposite stalks of the umbels in the panicles. It is traced to New England and the Upper Barcoo.

E. drepanophylla, which was advanced with much hesitation as a species (*flora Australiensis* iii. 221), seems mainly to differ in more stunted habit, larger and stiffer leaves of a paler hue, larger flowers and fruits and perhaps different bark. This species or variety, for the elucidation of which further field-studies are needed, extends northward to the Palmer-River (Th. Gulliver), Cape Sidmouth (C. Moore) and Trinity Bay (Walter Hill) and on the authority of Bentham even to the north-west coast of Australia (Cunningham).

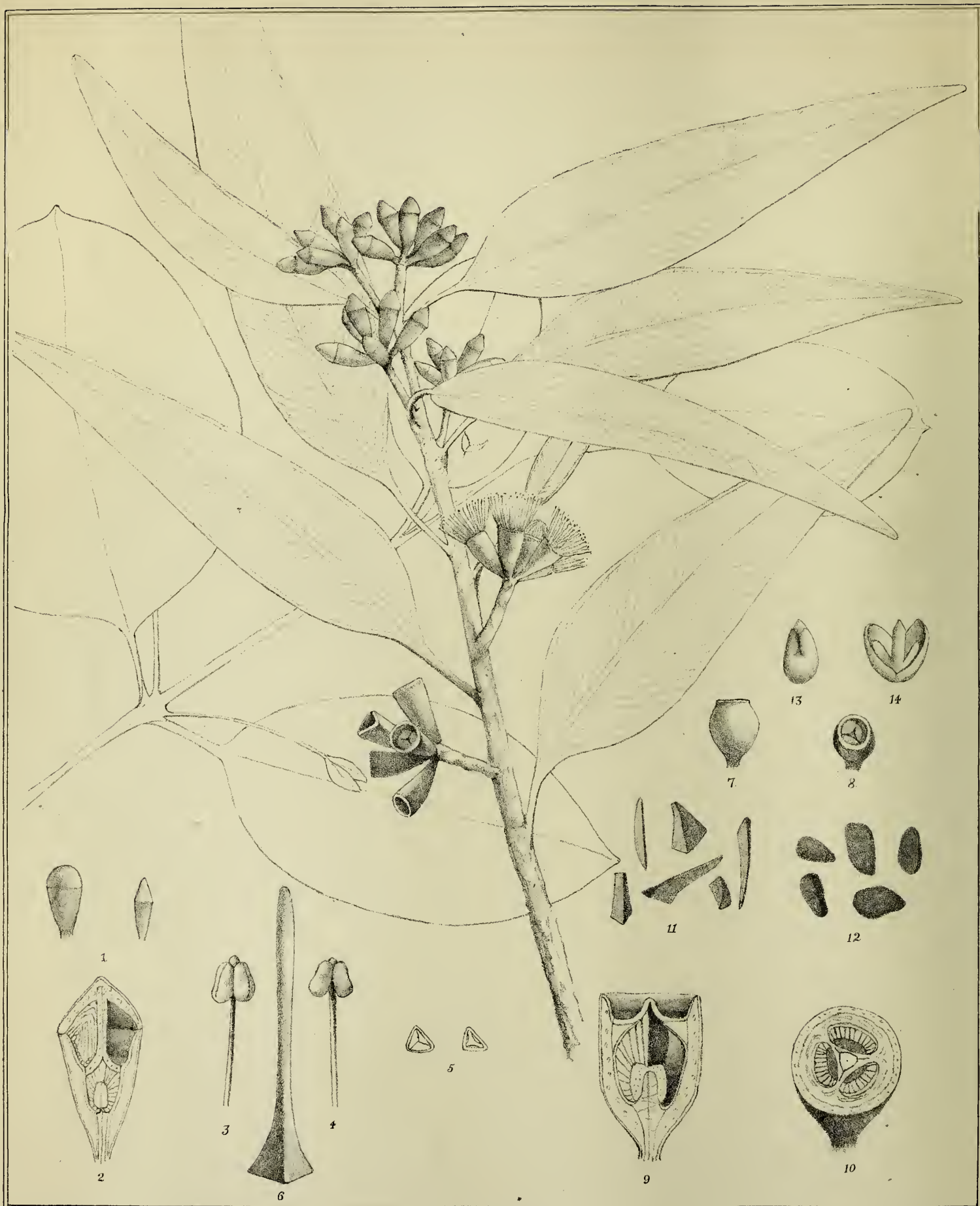
E. leptophleba has the bark more greyish, less furrowed and rather wrinkled, breaking up into numerous small angular pieces in the manner of *E. tessellaris* ; hence it belongs to the *Rhytiphloia* not *Schizophloia* ; its flowers remained unknown, but its lid is double in an early state of growth. To *E. leptophleba* seems also to belong a tree, observed by Mr. P. O'Shanesey on the Comet-River, which sheds the outer layers of its bark from the branches and upper part of the stem ; the persistent portion of the bark resembles that of *E. tessellaris*, but the leaves are more prominently veined and the fruit is often 5-valved and occasionally even 6-valved.

E. angustifolia (Woolls, *Lectures on the Vegetable Kingdom with special reference to Australia*, p. 123) is a form of *E. crebra*.

It seems not likely, that *E. paniculata* will ever be taken for *E. crebra*, as the leaves of the latter are never much unlike in the color of their two pages, as all the stamens are fertile, the anthers opening in their whole length and the fruits usually smaller and less angular.

Bentham quotes *Metrosideros salicifolia* (Solander, in *Gærtner de fructibus et seminibus* i. 171, t. xxxiv. *b.*) as belonging to this species ; the rather slender fruit as illustrated renders the identification disputable. *Gærtner* described the embryo well. The figure *a* remains still more obscure ; it may belong to *E. crebra*, *E. hæmastoma* or *E. amygdalina*.

EXPLANATION OF ANALYTIC DETAILS.—1, unexpanded flowers of different forms, the lid of one lifted ; 2, longitudinal section of an unexpanded flower ; 3 and 4, front- and back-view of an anther with the upper portion of its filament ; 5, style and stigma ; 6, various fruits ; 7 and 8, longitudinal and transverse section of a fruit ; 9, seeds ; 10, embryo ; all more or less magnified.



R. Austen del. et lith.

Baron von Mueller direxit

C. Troedel & Co. imp.

Eucalyptus diversicolor F. & M.

EUCALYPTUS DIVERSICOLOR.

F. v. M., fragmenta phytographiæ Australiæ iii. 131 (1863); Bentham, flora Australiensis iii. 251; F. v. M., Report on the Forest-resources of Western Australia, p. 6, t. 4.

The "Karri."

Finally extremely tall; *leaves* scattered, broad- or elongated-lanceolar, not very inequilateral, slightly curved, evidently *paler beneath*; *veins very numerous, subtle, pennately spreading*, the circumferential vein somewhat removed from the edge; oil-dots irregular and much concealed; umbels axillary and soon lateral, solitary, their stalks rather long and slender, slightly or not angular, with 3 to 9 flowers; calyces not shining, their tube gradually attenuated into a generally shorter stalklet, somewhat longer or nearly twice as long as the almost hemispheric or semioval lid, not or slightly angular; stamens all fertile, inflexed before expansion; *anthers almost heart-shaped*, bursting with longitudinal slits, enlarged by a conspicuous dorsal-terminal gland; style shorter than the stamens; stigma not dilated; fruits truncate-ovate, 3- or rarely 4-celled; rim flat, but rather narrow; *valves enclosed, cohering before maturation into a pyramidal cone*; seeds without appendage.

In the moist hilly or mountainous country at and near the Frankland- and Walpole-Rivers, the Shannon, Warren- and Dunolly-Rivers, more particularly towards the coast, extending about thirty miles or less inland, reaching the country near the entrance of the Blackwood-River (J. Forrest), constituting the Karri-forests, occurring sparingly also at the Porongurup and Torbay (F. v. M.) and around Mount Manypeak (Maxwell).

One of the grandest trees of the globe and one of the greatest wonders in the whole creation of plants! Astounding records of the height of this giant-tree have been given. Messrs. Muir saw trees with stems about 300 feet long up to the first branch, and I myself noticed many trees, which approached to 400 feet in their total height. When closely growing, the young trees may have a comparatively slender trunk, so much so, that a tree 180 feet high may show a stem hardly over a foot in diameter; in such a case the foliage, for want of space, is also only scantily developed, and the ramifications are but short in proportion to the tallness of the stems. In the mast-like straightness of the trunk and the smooth whiteness of its bark this superb tree imitates completely the variety regnans of *E. amygdalina* of South-East Australia, with which also, and perhaps solely, it enters into rivalry as *the tallest tree of the globe!* Even the loftiest trees may not yet have been found out in the secluded humid forest-valleys, in which *E. diversicolor* like *E. amygdalina* rejoices most and luxuriates to the greatest extent. But possibly in the 200 miles of uninterrupted length of Sequoia-forests, a few years ago rendered known to exist in Southern California, Mammoth-trees of either Sequoia Wellingtonia or *S. sempervirens* may occur, which possibly excel in stupendous height even the famous individual trees of the Calaveras-Grove. But whatever species of tree in the championship of the world may gain the final victory for height, no Eucalyptus can compare in the massiveness of its trunk with the Wellingtonia Sequoia, of which one on the Tule-River showed a basal trunk-diameter of 35 feet, while at a height of 240 feet the stem-diameter was still 12 feet with two succeeding limbs respectively 10 and 9 feet across. Still on the authority of Captain Walcott also Karri-stems have been observed with a basal diameter of 20 feet. Into this final competition for height may perhaps also enter some of the true Pines of North-West America (*Pinus Douglasii*, *P. Lambertiana*, *P. Menziesii*, *P. grandis*) and even the North-East American *Pinus Strobus*, though its most majestic specimen-trees were long ago swept ruthlessly away from the face of the globe, a fate not unlikely to be shared by its

EUCALYPTUS DIVERSICOLOR.

compeers elsewhere. Widths of timber of as much as 12 feet can be obtained from *E. diversicolor*. The wood is light-colored, bends freely, is of straight grain and tough, but not so easily wrought as that of *E. marginata*; it is particularly in request for large planks and sought also for shafts, spokes, felloes and rails; it has also come into use for shipbuilding—for planks, rudders and even masts. According to a note in the West-Australian Catalogue of the Paris Exhibition of 1878 a baulk, which at Cape Leeuwin had been exposed to the wash of the tides since twenty-six years, continued still sound. The durability of the timber, when for lengthened periods underground, has as yet not been proved.

Mr. Th. Laslett (*Timber and Timber-Trees*, p. 198) states the results of his experiments on the strength of Karri-wood to be as follows. The pieces experimented on for deflection measured 7 feet in length by 2 inches square, six different trials being made :—

DEFLECTION.

—				Under a Pressure of 390 lbs.	After the Weight was removed.	At the moment of breaking.	Total Weight required to break each piece.
				Inches.	Inches.	Inches.	lbs.
Maximum	...	...	...	1·35	0·10	7·50	955
Minimum	...	...	...	0·75	0·0	4·60	725
Mean	...	...	...	1·01	0·4	6·06	862½

English Oak of the same dimensions supported a weight of 806½ lbs. (average of twelve trials).

Mr. Laslett's experiments on the tensile strength of Karri-timber gave the following results, the pieces being 30 inches long by 2 inches square : Maximum weight borne, 31,360 lbs. ; minimum, 22,120 lbs. ; average of six experiments, 28,280 lbs.

Cubes of 6 inches bore a crushing strain of from 175 to 195 tons, average 185 tons, or per square inch 5·14 tons. The specific gravity of the wood was found to be from 0·885 to 1·023, average 0·981.

The first records given by collectors of the bark and other characteristics of this species did not lead to the identification of the huge trees of the Karri-ales; this circumstance and some disparities of characteristics led to the belief, that the gigantic Karri was specifically different, and hence it became temporarily distinguished as *E. colossea*, under which very impressive designation it chiefly still passes in the countries around the Mediterranean Sea, where this noble Eucalypt, with numerous other species, was first introduced by the writer. The specific name, which by priority has claim on permanency, was derived from the color of the leaves, different on both sides. The growth of the tree is comparatively quick; in poor sandy soil near Melbourne about 23 feet in nine years. The leaves of very young trees assume a broader more oval form, as is the case with many other congeners; in small seedlings the leaves are already conspicuously stalked. Young branchlets compressed-quadrangular. Bruised foliage of Cajuput-odor. Leaves more or less shining above. Unexpanded calyx clubshaped-ellipsoid. Lid rarely broad-conical. Filaments whitish. Anthers dorsifixed. Fruits attaining a length of fully half an inch, moderately contracted towards the orifice. Valves sometimes much narrowed upwards. Fertile seeds dull-black, almost ovate, plan-convex; sterile seeds much more numerous, considerably smaller, light-brown, irregular in form, many very narrow.

EUCALYPTUS DIVERSICOLOR.

Drummond's collections contain this species under Nos. 39 and 59.

E. diversicolor among West Australian species bears some similarity to *E. marginata*, but the leaves are still paler beneath, the lid is almost constantly shorter, particularly so in proportion to the tube of the calyx, the anthers are not broader than long and their glandular protuberance is much larger, the fruit is longer in comparison to its width, the valves are also longer and the seeds very much smaller; besides bark and wood are totally different.

The Karri-tree cannot in nature be confused with *E. patens*, the Blackbutt-tree of West-Australia, on account of the greatly persistent and rough bark of the latter, which has besides more curved leaves of almost equal coloration on both sides, the anther-gland very faint, the fruit-rim narrower, the valvular portion of the fruit at first flat and consisting usually of four rarely five pieces, the seeds larger.

What as *E. goniantha* is mentioned by Bentham from the Frankland-River belongs to *E. diversicolor*.

The diametric measurement of the woody fibre, and the proportionate number of the medullary rays and vascular tubes, as contrasted with their copiousness in some other kinds of *Eucalyptus*-woods, is set forth in the following columns, whereby some idea of the relative density of the timber and the closeness of the woody texture may be obtained.

MEASUREMENT OF TRANSVERSE SECTIONS OF THE CELLS OF WOODY FIBRE (PROSENCHYMA).

1. Largest Diameter of Cell.				2. Thickness of Cellwall.			
<i>Eucalyptus marginata</i> (hard) ...	...	...	·00082 inch	<i>Eucalyptus marginata</i> (hard) ...	...	...	·00019 inch
marginata (light, dense) ...	...	...	·00082 "	marginata (light, dense) ...	...	...	·00024 "
marginata (ordinary, soft) ...	...	...	·00082 "	marginata (ordinary, soft) ...	...	...	·00030 "
diversicolor ...	...	...	·00129 "	diversicolor ...	...	...	·00038 "
longicornis ...	...	...	·00070 "	longicornis ...	...	...	·00029 "
calophylla ...	...	...	·00101 "	calophylla ...	...	...	·00033 "
loxophleba ...	...	...	·00063 "	loxophleba ...	...	...	·00023 "
salubris ...	...	...	·00055 "	salubris ...	...	...	·00023 "
cornuta ...	...	...	·00082 "	cornuta ...	...	...	·00037 "
rostrata ...	...	...	·00082 "	rostrata ...	...	...	·00020 "
globulus ...	...	...	·00082 "	globulus ...	...	...	·00020 "
Stuartiana ...	...	...	·00082 "	Stuartiana ...	...	...	·00015 "
Baileyana ...	...	...	·00105 "	Baileyana ...	...	...	·00025 "
Doratoxylon (young) ...	...	...	·00072 "	Doratoxylon (young) ...	...	...	·00022 "

NUMBER of Medullary Rays within the space of 1 inch in—

<i>Eucalyptus marginata</i> (dark hard variety)...	390	<i>Eucalyptus loxophleba</i> ...	...	...	330
marginata (light dense variety) ...	260	salubris ...	...	...	470
marginata (soft variety) ...	330	cornuta ...	...	...	670
diversicolor ...	170	rostrata ...	...	...	390
longicornis ...	290	globulus ...	...	...	310
calophylla ...	180	Stuartiana ...	...	...	180
Baileyana ...	315	Doratoxylon (young) ...	...	...	330

NUMBER of Vascular Tubes within 1 square inch in the Wood of—

<i>Eucalyptus marginata</i> (dark hard variety) ...	3,500	<i>Eucalyptus loxophleba</i> ...	...	...	25,000
marginata (light dense variety) ...	2,700	salubris ...	...	...	42,000
marginata (soft variety) ...	5,100	cornuta ...	...	...	10,000
diversicolor ...	4,900	rostrata ...	...	...	5,700
longicornis ...	9,300	globulus ...	...	...	3,600
calophylla ...	3,300	Stuartiana ...	...	...	6,300
Baileyana ...	10,000	Doratoxylon (young) ...	...	...	32,000

EUCALYPTUS DIVERSICOLOR.

These proportions will be subject to some variation, according to the age of the trees. These measurements were made under the author's direction by Mr. L. Rummel.

E. diversicolor seems as hardy as *E. globulus*, though it may prove less so than *E. amygdalina*, *E. Gunnii*, *E. pauciflora*, *E. viminalis* and even *E. obliqua*, *E. Sieberiana* and *E. goniocalyx*, among the larger kinds of timber-trees of this genus. Dr. Aberg finds, that on the entrance of the La Plata-River *E. diversicolor* turns out one of the fastest in growth, and if the species was rightly determined *E. corymbosa* carried there besides *E. globulus* the palm, *E. obliqua* and *E. siderophloia* coming next in this respect. On the rich alluvial soil there grew also comparatively fast: *E. Gunnii*, *E. Leucoxylon*, *E. hæmastoma*, *E. largiflorens*, *E. longifolia*, *E. goniocalyx*, *E. cornuta*, *E. rostrata*, *E. tereticornis* and *E. maculata*, but the latter with *E. marginata* and *E. calophylla* suffered there from frost. Many grew in that region from two to even five inches daily during the most favorable time of the season!

When gradually through the progress of settlement the harbors between King George's Sound and Cape Leeuwin will be opened up for trade, Karri-timber will become extensively available for export also.

EXPLANATION OF ANALYTIC DETAILS.—1, unexpanded flowers of two forms; 2, longitudinal section of an unexpanded flower; 3 and 4, front- and back-view of an anther with portion of its filament; 5, pollen-grains; 6, style and stigma; 7 and 8, lateral and vertical view of a fruit; 9 and 10, longitudinal and transverse section of a fruit; 11 and 12, sterile and fertile seeds; 13, embryo; 14, cotyledons unfolded, to exhibit the radicle; 1, 7 and 8, natural size; 2, 3, 4, 6, 9-14, moderately magnified; 5, enlarged 250 times diametrically.



Tab. del. C. Trudel & Co. Lith.

F. v. M. direct.

Steam Litho. Gov. Printing Office Melb.

Eucalyptus hemiphloia. F. v. M.

EUCALYPTUS HEMIPHLOIA.

F. v. M., *fragmenta phytographiæ Australiæ* ii. 62 ; Bentham, *flora Australiensis* iii. 216 ; E. albens, Miquel, in *Nederlandisk Kruidkundig Archief* iv. 138 ; Bentham, *flora Australiensis* iii. 219.

Finally tall ; leaves scattered, elongate- or oval-lanceolar, of firm consistence, of equal color on both sides, only slightly or sometimes moderately curved, not very shining, the *lateral veins diverging at a very acute angle*, the circumferential vein very evidently removed from the edge of the leaf ; oil-dots usually obliterated or much concealed ; umbels in lateral or terminal short panicles or some solitary, on angular stalks, with from 4 to 10 flowers ; *calyces somewhat angular* ; stalklets comparatively thick, of the length of the tube or shorter ; lid broadish-conical, rather acute or even pointed, seldom semiovate, about as long as the tube or somewhat shorter ; stamens all fertile, inflexed before expansion ; *anthers very minute, globular, opening laterally by pore-like apertures* ; stigma slightly or not broader than the style ; fruits truncated-ovate or hemiellipsoid, 3-5-celled, the *rim narrow-compressed, prominent, valves quite enclosed*, short ; seeds without any appendage, the fertile much larger than the short sterile seeds.

Dispersed from Port Jackson (Woolls) to New England (C. Stuart), Glendon (Leichhardt), Toowoomba (Hartmann) and the western districts of New South Wales (C. Moore), Gainsford and Herbert's Creek (Bowman), the Dawson- and Burnett-Rivers (F. v. M.), Mackenzie-River (O'Shanesy), occurring further on the Tambo-River (Howitt) and Snowy-River, also from the Broughton- and Broken-Rivers to Mount Remarkable (F. v. M.), on the Flinders-Ranges up to 2,000 feet elevation (J. E. Brown). It grows on flats, often forming the "box-forests," but principally on rough and dry ridges or hills, yet indicating according to the Revd. Dr. Woolls, often good grazing country.

In the more humid litoral tracts of east- and south-coast Australia this species attains a height of about 150 feet, with a stem of as much as 3 feet thickness (Thozet) ; in the drier regions of northern Victoria and further westward it is oftener a dwarf tree. The bark of the stem persists, is solid, outside greyish and somewhat wrinkled, but never dark nor deeply furrowed, the outer layers of the bark gradually peel off from most portions of the branches in flakes or long strips. The timber is pale, strong, hard, of close and interlocked grain and not fissile ; it furnishes material for lasting fence-posts and various building purposes and wheelwrights' work, also for such sundry utensils as need toughness of wood for their manufacture, as mauls and handles. Posts of this wood after sixteen years were found almost perfectly sound in the ground, but the best timber (as in all other cases of Eucalypts) comes from hilly country. Stems are apt to become hollow in age (J. E. Brown).

Foliage comparatively dense ; upper portion of branchlets angular ; leaves stiff, conspicuously stalked, often pale-green, but in the eastern coast-districts also dark-green, their veins sometimes prominent, sometimes faint. The tube of the calyx often merging gradually into the stalklet ; lid in some instances double, the outer one seceding earlier. Filaments pale or rarely of a deep purplish color, exceptionally $\frac{1}{3}$ inch long ; some of the anthers occasionally dilated. Summits of the valves often long cohering and breaking off connectedly. Fruit variable in size, but never large. Dr. Leichhardt found the tree flowering in March, Dr. Woolls in June, particular seasons and localities exercising their effect in this respect. The natives of subtropical Eastern Australia call this tree "Narulgum," according to Mr. O'Shanesy.

E. albens, which occurs near Mount Remarkable and in some other localities not far from the apex of Spencer's Gulf, also in the vicinity of the Avoca, Loddon, Campaspe, Broken, Ovens and Snowy Rivers (F. v. M.), along the whole valley of the Tambo (Howitt), on the Upper

EUCALYPTUS HEMIPHLOIA.

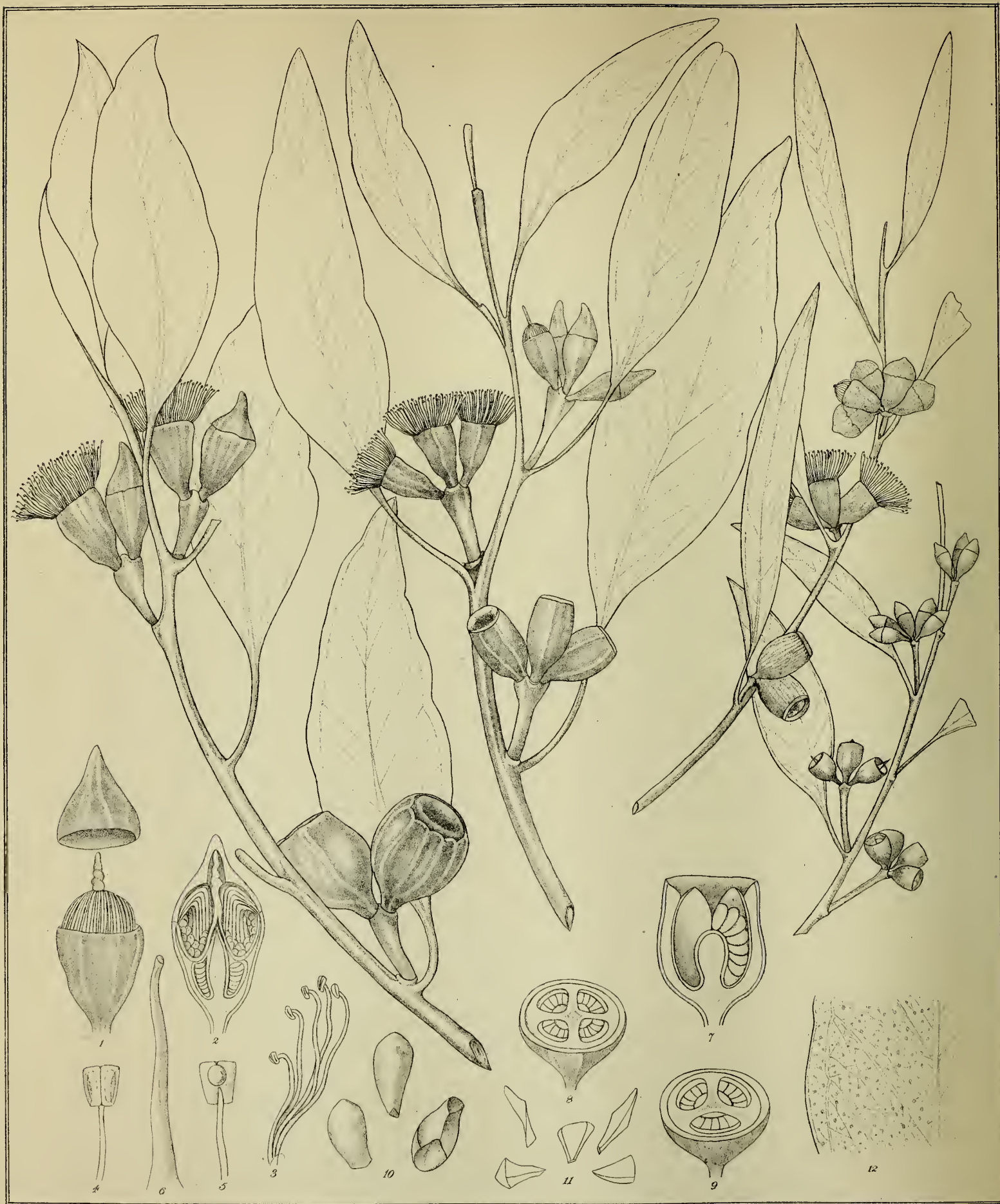
Murrumbidgee in silurian shales and sandstone, also more or less on all geologic formations on the western slope of the Main Dividing Range of New South Wales down to the tertiary plains (Wilkinson) verging northward to New England (C. Stuart), can be distinguished from the typical *E. hemiphloia* only in perhaps more extensively persistent bark, in paler dull foliage and chalky-white bloom on the panicles and in calyces somewhat larger and tapering more gradually into a thicker stalklet. The name of *E. albens* only arose from a misprint of *E. pallens* and was first promulgated without any diagnosis, and this specific designation is apt to mislead, as the whitish hue, significant of *E. albens*, and for which it is called "White Box-tree" occurs only in a particular variety chiefly of the western interior, where even this characteristic is often not more remarkable than in several other congeners.

E. hemiphloia is nearest allied to *E. populifolia*, *E. Behriana* and *E. odorata*; from the first it differs in the laminar secession of the bark from the branches, in longer, narrower and less shining leaves, in larger flowers on more elongated stalklets, longer more pointed lid, apertures of the anthers not so close to the summit, and larger and especially more elongated fruits with valves somewhat removed from the orifice.—From *E. Behriana*, which stands in close relationship to *E. largiflorens*, it is less easily distinguished in all cases, but it is often of taller stature, not so often remaining shrubby, the bark is lighter in color and not smooth by secession of outer rather dark-brownish layers; the leaves are longer and in proportion to their length usually narrower, also mostly of lighter color, the panicles ampler (those of *E. Behriana* being comparatively narrow), the flowers and fruits are larger and provided almost as a rule with distinct stalklets, the tube of the calyx is somewhat angular, and the lid is never hemispherical; *E. hemiphloia* recedes from *E. odorata* in the external paleness of the persistent portion of its bark, in the more extensive secession of the bark from the branches, in the broader leaves of thicker consistence with less spreading and less copious veins and less distinguishable oil-dots, in not usually solitary axillary umbels, often more acute lid and more deeply inserted valves of the fruit. The reliability of these distinctions should be further traced in South Australia, wherever the two species grow promiscuously. *E. hemiphloia* seems readily separable from *E. Bowmanii* by the less spreading veins of the leaves, more paniculate umbels on less flattened stalks, upwards more attenuated lid, stamens much more inflexed while in bud, the openings of the anthers less wide, and the flat top of the ovary, which has a semiglobular-conical summit in *E. Bowmanii*; the fruit of the latter is not yet available for comparison.

E. drepanophylla, which comes very near to *E. leptophleba* and *E. crebra*, belongs to the series of Ironbark-trees (with therefore furrowed and dark-colored bark), has usually narrower leaves of less straightness and of lighter green, with very subtle much diverging and also more copious veins, a shorter lid, anther-cells slit in their whole length and proportionately shorter fruits. To *E. drepanophylla* verges Bentham's variety *parviflora* (*flora Australiensis* iii. 217) mentioned doubtfully under *E. hemiphloia*; it is according to Fitzalan's note on Ironbark-tree, the anthers however seem not to open with regular slits. The often angular fruit of *E. hemiphloia* reminds of that of *E. goniocalyx*, which species however does not pertain to the section *Micrantheræ* and is moreover recognized already by the flatness of its flowerstalks.

EXPLANATION OF ANALYTIC DETAILS.—1, calyx, the lid lifted; 2, longitudinal section of an unexpanded flower; 3, stamens in situ; 4, and 5, front- and back-view of an anther with portion of filament; 6, style and stigma; 7, longitudinal section of fruit; 8, transverse section of fruit; 9 and 10, fertile and sterile seeds; 11, portion of leaf; all (but variously) magnified.





Edt by G. Troedel & Co. Lith.

F. v. M. direct.

Steam Litho Gov. Printing Office Melb.

Eucalyptus incrassata. Labillardière.

EUCALYPTUS INCRASSATA.

Labillardière, plantarum Novæ Hollandiæ specimen ii. 12, t. 150 (1806); De Candolle, prodromus systematis naturalis regni vegetabilis iii. 217; Bentham, flora Australiensis iii. 231; *E. dumosa*, Cunningham in Walpers repertorium botanices systematicæ ii. 925; F. v. M., fragmenta phytographiæ Australiæ ii. 59; Bentham, flora Australiensis iii. 230; *E. angulosa*, Schauer, in Walpers repertorium ii. 925; *E. cuspidata*, Turczaninow, in Bulletin de la Société des Naturalistes de Moscou 1849, ii. 21; *E. costata*, Behr & Mueller, in the Transactions of the Victorian Institute i. 33; *E. santalifolia*, *E. lamprocarpa* et *E. Muelleri*, Miquel, in Nederlandisk Kruidkundig Archief iv. 129, 130 and 133; *E. fruticetorum*, F. v. M., fragmenta phytographiæ Australiæ ii. 57.

Shrubby or hardly arborescent; leaves scattered, ovate- or narrow-lanceolar, sometimes broad-ovate, of thick consistence, of equal and light color as well as shining on both sides; the lateral veins somewhat close, spreading at a rather acute angle and together with the oil-dots much concealed, the circumferential vein visibly distant from the edge; umbels solitary, axillary or subsequently lateral, their *stalks thick, compressed, upwards much dilated* or sometimes more cylindrical, bearing usually from 3 to 8 flowers; stalklets very short or almost or quite undeveloped; *calyces shining, generally streaked with longitudinal prominent lines*, the tube semioval or somewhat bellshaped; lid about as long as the tube or somewhat longer or conspicuously shorter, turgid towards the base, often rather suddenly protracted into a short or elongated and then slender apex; stamens all fertile and inflexed before expansion; anthers from roundish-oval to almost oblong, opening by ample longitudinal slits; style rather thick; stigma not dilated; fruit semioval or truncate-ovate, imperfectly or deeply furrowed and streaked, 3-4- rarely 5-celled, the rim oftener narrow than conspicuously broad, seldom flat; valves quite enclosed or their fragile and pointed ends only exerted; sterile seeds usually much narrower than the fertile seeds, all without appendage.

From the Murray- and Darling-Rivers and their lower tributaries through the desert-tracts to the Great Bight, to Cape Leeuwin and to the vicinity of Shark-Bay, chiefly on sand-ridges, but also on tertiary limestone, extending in some places to the brink of the ocean.

A shrub usually of tall growth, with several stems from the same root, exceptionally rising to a tree up to 30 feet, but fruiting already at a height of 4 feet. Bark smooth, outside of a whitish or reddish color, shedding its outer layers successively. Branchlets rather thick, angular and rigid, not pendent. Leaves hardly inequilateral, often terminated by a narrow and curved acumen. Leafstalks of conspicuous length, exceptionally very short. Umbel-stalks sometimes almost wedgeshaped, seldom bearing only two flowers, not rarely curved downward. Lid sometimes slightly wider than the tube of the calyx, occasionally broad-conical or even pyramidal-hemispherical, the end (when beak-like extended) sometimes longer than the turgid basal portion of the lid. Filaments in bud simply inflected, but not flexuous, nor sharply doubled back, comparatively rigid. Some of the anthers occasionally verging to a globular-cordate form; the connective conspicuously glandular-turgid at the back. Style exerted beyond the stamens while they are bent inward before expansion. Fruit-calyx attaining in some cases a length of nearly 1 inch, but that of the small-flowered variety often only $\frac{1}{4}$ to $\frac{1}{2}$ inch long, exceptionally quite hemispherical.

Among the species, constituting the Mallee-scrub on an extensive scale, only *E. oleosa* belongs also to the Parallelantheræ, from which *E. incrassata* can be distinguished by its often broad and flat flowerstalks, furrowed or streaked and mostly larger shining calyces, with a lid more depressed towards the base, generally more elongated anthers, as also shorter and therefore less exerted fruit-valves. *E. goniantha* comes still nearer to *E. incrassata*, but the leaves are somewhat more distinctly sickleshaped, not so shining nor of such even smoothness, but slightly reticulated on their surfaces, the tube of the calyx is comparatively still more deeply furrowed, the attenuated

EUCALYPTUS INCRASSATA.

upper portion of the lid broader and more blunt, while the anthers seem invariably heartshaped-globular, so far as this plant, of which we have as yet no ripe fruit, is known.

E. micranthera, which is closely connected with the arboreous and soft-barked *E. decipiens*, differs from the genuine *E. incrassata* particularly in its very short and almost heartshaped anthers, but in other respects comes near to the variety so long separated as *E. dumosa*.

E. grossa (from which *E. pachypoda*, F. v. M., *fragmenta phytographiæ Australiæ* vii. 41 anno 1869, is only separable as a variety) can best be distinguished from *E. incrassata* by its not distinctly compressed though stout umbel-stalks, by the slightly angular but not furrowed tube of the calyx, by the semiellipsoid even lid, by the filaments inflexed near or towards the summit only, and by its not angular fruit with no narrow apex of the valves.

The specific name, adopted by the French naturalist, seems to refer to the leathery thickness of the leaves, which however is observable in many other species. *E. dumosa* represents the small-flowered state with generally narrower leaves, only faintly furrowed and ridged calyces, short-pointed lid and scarcely dilated umbel-stalks.

Poiteau's drawing of *E. incrassata* for Labillardière's work can only with difficulty be reconciled to the species here under consideration, as the lateral veins of the leaves are shown too spreading and too prominent and the calyces quite devoid of furrows and streaks, to which Labillardière neither alludes in his description, although some specimens, which I gathered at King George's Sound, but which are aberrant from the common form of *E. incrassata*, accord sufficiently with the figure authoritative for this species. To this smooth-fruited variety approaches very closely *E. cosmophylla*, from the Stringybarktree-forests of the mountains on St. Vincent Gulf, which species shows however more pointed generally broader and less shining leaves with more visible veins, the flowers less in number and on a shorter common stalk and rather an increase in the number of fruit-valves.

E. Planchoniana approaches in some of its characteristics *E. incrassata*, but irrespective of its not belonging to the desert-country, it is a comparatively tall tree, the leaves are longer, not so shining, have more spreading, more distant and more prominent veins and their stomata only on the lower page, the tube of the calyx is less turgid, the lid more gradually attenuated upwards, the anthers are never elongated to an oblong form, the outer stamens are not bent downward while in bud, but are somewhat flexuous, the valves of the fruit are not narrowly attenuated at their apex, and the fertile seeds are more angular.

E. incrassata is one of the prevailing species among those, which widely constitute the dense "Mallee-scrub," and plays thus an important part in the natural economy of the desert, aiding to mitigate the excessive heat and the effect of Sirocco-like blasts of widely arid regions by its enormous power of evaporation, in which respect Eucalypts generally far surpass most other kinds of trees, the power of their roots for drawing up and absorbing humidity from the soil being also very great. It is well known that *E. incrassata*, *E. microtheca* and *E. oleosa* will yield water to a parched traveller from their roots.

EXPLANATION OF ANALYTIC DETAILS.—1, unexpanded flower, the lid lifted; 2, longitudinal section of unexpanded flower; 3, some stamens in situ; 4 and 5, front- and back-view of an anther, with portion of its filament; 6, style and stigma; 7, longitudinal section of a fruit; 8 and 9, transverse section of fruits; 10 and 11, fertile and sterile seeds; 12, portion of a leaf; all magnified, but to various extent.



Edw. & C. Lith.

F.v.M. direct.

Eleam Litho. Gov. Printing Office. Melb.

Eucalyptus largiflorens. F.v.M.

EUCALYPTUS LARGIFLORENS.

F. v. M., in the Transactions of the Victorian Institute i. 34 (1854); fragmenta phytographiæ Australiæ ii. 58; E. pendula, A. Cunningham, in Steudel's nomenclator botanicus p. 600 (1840); E. bicolor, A. Cunningham, in Mitchell's Tropical Australia 390 (1848); F. v. M., in the Journal of the Linnean Society iii. 90; Bentham, flora Australiensis iii. 214.

Branchlets slender; leaves scattered, elongated- or very narrow-lanceolar, rather straight or slightly sickles shaped, of thin consistence, gradually narrowed into a comparatively short stalk, generally pale and dull-green on both sides; lateral *veins extremely fine, diverging at a very acute angle* or not very spreading nor quite close, the circumferential vein somewhat removed from the edge; oil-glands numerous, often transparent; *umbels in lateral or terminal short panicles*, with 3-8 flowers in each; calyces small, on stalklets of usually less length; *lid double, the inner one hemispherical* or slightly pyramidal, hardly half as long as the almost obconical-semiovate scarcely angular tube, the outer lid when present much smaller and slightly elevated; stamens all fertile, unless some of the outer imperfect, inflexed before expansion; *anthers globular, opening by lateral pores*; style very short; stigma hardly dilated; *fruit very small, truncate-ovate* or slightly bell-shaped, 3- or oftener 4-celled; the rim rather narrow, the valves very short, convergent and quite enclosed, but not distant from the rim; seeds minute, without appendages.

From St. Vincent's Gulf and the Murray-River and its lower tributaries through Eastern Australia and particularly its inland-tracts to Carpentaria, at least as far as the Flinders- and Gilbert-Rivers, but reaching also in some places the coast-tracts.

A tree, attaining in desert-regions only a height of about 30 feet or remaining more or less shrubby, but in litoral regions rising to about 90 feet, passing as one of the "Box-trees," occupying either moist places or banks of watercourses or depressions in the Mallee-scrub. *Bark persistent* in the ordinary state of this species on the branches as well as on the stem, blackish-grey, rough and hard. Branches more or less drooping, sometimes as much so as those of the Weeping Willow. Leaves occasionally a span long, but usually rather short,—in trees from the east-coast, which seem as a variety to belong to this species, also vivid-green and somewhat shining. Stalks of the umbels neither elongated nor dilatated. Stalklets sometimes extremely short. Outer lid not always independently developed or very fugacious or consolidated with the inner one. Filaments in bud, irrespective of their sudden infraction, also flexuous, cream-colored as in most congeners or occasionally crimson; the anthers of the outer filaments sometimes diminutive or almost obliterated, or rarely a few of them enlarged and deformed. Valves exceptionally 5.

This is not the only instance of tall eastern species extending far into the western interior and there becoming dwarfed in growth, E. paniculata and E. hemiphloia being other examples in this respect.

The supposed tall variety from the Queensland coast-districts, with longer leaves of more saturated and rather shining green, sheds the outer layers of its bark completely, according to a note of Mr. Dallachy, but seems not specifically different. Similar instances are well known in regard to the coloration of the foliage of Tecoma australis, Carissa Brownii, Geijera salicifolia and Jasminum simplicifolium, which produce dark-green shining leaves in humid forest-regions, but assume gradually a pale and dull hue as these plants advance towards the arid interior. The lamellar secession of the bark in trees of this species in coast-forest and its persistence in dry open regions finds a repetition under similar circumstances in E. amygdalina and several other congeners. The stalklets in this variety from the tropical coast are rather longer and the lid

EUCALYPTUS LARGIFLORENS.

more pyramidal. Mr. O'Shanesey records from the Dawson-River and Nagoa trees with bark black on the stem and grey and smooth on the limbs.

Preference is here given, in accordance with De Candolle's code, to the name under which this species was first defined, and chosen as expressive of the exuberance of its flowers. Of neither of the names, bestowed by Allan Cunningham on this species, timely description was given; the pendulous branches suggesting the one name and perhaps the sometimes red but often pale color of the filaments giving rise to the other, unless it was derived from the coloration of the bark. Crimson filaments seem however not to occur frequently, though the writer has seen flowers of such mixed with others of pale-colored stamens in the same panicle. Flowers with red filaments are less rare in *E. Leucoxydon*, occur also in *E. Behriana*, according to Mr. T. Shepherd rarely in *E. hemiphloia* and seemingly likewise in *E. siderophloia*. They are perhaps always red in *E. erythronema* (Turczaninow, in Bulletin de l'Académie des Sciences de St. Petersbourg 1852 p. 415; *E. conoidea*, Benth, flora Australiensis iii. 227).

The resemblance of *E. Behriana* to *E. largiflorens* is very great, but the former has more erect branchlets, also stiffer, broader and more shining leaves, the flowers almost unprovided with stalklets, besides often longer fruits.

E. odorata again is distinguished by the generally broader leaves, simple axillary umbels, more elongated calyces tapering rather more gradually into the stalklets, by longer lids, larger anthers and longer fruits not contracted at the orifice.

E. microtheca shows more numerous and very spreading veins of the leaves, the circumferential vein almost contiguous to the edge, anthers opening by slits not pores, fruits remarkably distended at the orifice with protruding valves.

E. crebra may be distinguished easily by its dark rugged bark—belonging to the series of the Ironbarks—further by the fine close and very spreading veins of the leaves and by the anthers opening by fissures.

Benthams var. *parviflora* of *E. largiflorens* belongs to *E. populifolia*.

EXPLANATION OF ANALYTIC DETAILS.—1, unexpanded flower with a double lid; 2, unexpanded flower, the lid lifted; 3, longitudinal section of an unexpanded flower; 4 and 5, stamens in situ, either all fertile or some sterile; 6, 7 and 8, back-, side- and front-view of an anther with portion of its filament; 9, style with stigma; 10 and 11, transverse and longitudinal section of fruit; 12 and 13, fertile and sterile seeds; 14, portion of a leaf; all magnified, but in various degrees.



R. Austen del. et lith.

P. v. M. direxit

Steam Litho. Gov. Printing Office. Melb.

Eucalyptus *paniculata* . *Smith*

EUCALYPTUS PANICULATA.

Smith, in the Transactions of the Linnean Society iii. 287 (1797); De Candolle, prodromus systematis naturalis regni vegetabilis iii. 220; Kippist, in F. v. M. fragmenta phytographiæ Australiæ ii. 174; Bentham, flora Australiensis iii. 211; E. fasciculosa, F. v. M., in the Transactions of the Victorian Institute i. p. 34; Miquel, in Nederlandisk Kruitkundig Archief iv. 138.

Finally tall; *leaves* scattered, of rather thin consistence, narrow- or elongate- or sometimes broad-lanceolar, slightly curved or somewhat sickles shaped, *paler and dull-colored beneath*, hardly shining above, their lateral veins very spreading, subtle and numerous, the *marginal vein almost contiguous to the edge of the leaf*; oil-pores irregular, mostly angular, soon concealed; *umbels paniculated* or a few axillary and solitary, on slender angular stalks, each with from 3 to 8 flowers; tube of the calyx broad-obconical, gradually becoming angular, attenuated into a stalklet of generally lesser length, longer and broader than the pyramidal- or hemispheric-conical almost membranous lid or sometimes the latter almost as long as the tube; *outer stamens sterile*; filaments all infracted before expansion; *anthers minute, quadrangular-roundish, opening with pores at the truncated summit*; *stigma dilated*, evidently broader than the summit of the style; fruit truncate-ovate, attenuated at the base or verging into a truncate-pearshaped form, slightly contracted at the summit, 3-4- or rarely 5-celled, lined with 2 to 4 angular streaks, never large, their rim narrowly compressed; valves almost deltoid, quite enclosed; seeds all without appendage, the sterile seeds exceedingly short, angular and comparatively broadish; testa of fertile seeds reticulated.

In New South Wales from the coast to the Blue Mountains and New England (Leichhardt), extending there southward at least as far as Illawarra (Kirton); the variety fasciculosa on dry particularly sandy ridges and also on stony ranges near the Murray-River and St. Vincent's Gulf (F. v. M.), at Lacepede-Bay (Babbage) and some intermediate places, also in Kangaroo-Island (Waterhouse).

This species passes at or near the east-coast as the "Red Ironbark-tree," according to the Revd. Dr. Woolls, on account of its persistent hard rough bark and reddish dark timber. In South-Australia it is a White Gum-tree, seldom rising there above 30 feet, even often of less height, with the outer layers of bark deciduous, leaving the stem grey and white-mottled and smooth (McEwin). It flowers in a shrubby state already. These two races of E. paniculata differ furthermore in their foliage and in some other respects. Thus the leaves of the typical E. paniculata of Eastern Australia have their upper page much darker than the lower one and the stomata are hypogenous only, varying as far as observed from 137,000 to 186,000 on the square inch, whereas the difference in the coloration of both sides of the leaves is not striking, indeed pale also above in E. fasciculosa, the stomata being amphigenous, counting about from $\frac{20,000}{130,000}$ to $\frac{21,000}{132,000}$. Moreover the flowers of the variety fasciculosa are smaller, the lid is proportionately shorter and still more thinly membranous; but the foliage and inflorescence of E. paniculata assumes in New England also exceptionally a glaucous hue.

From E. melliodora the species here under consideration can be distinguished by mostly longer leaves with finer and more spreading veins and with the intramarginal vein nearer to the edge, further by more decidedly paniculate flowers, the somewhat angular calyx, which is more gradually attenuated into its stalklet, by the rather longer fruit-calyx with the rim inside long-descending but outside neither emerging nor annular.

EUCALYPTUS PANICULATA.

The differences of *E. paniculata* from *E. largiflorens* consist in the contrasting paleness of the lower page of the leaves and in their more copious and more divergent but less prominent veins, in the close approach of the circumferential vein to the margin of the leaf, in the pointed lid, in the deprivation of many of the outer stamens of their anthers and in the narrower rim of the fruit-calyx. It is also generally a taller tree, rising to 150 feet.

From *E. gracilis* it differs again in the inequality of the color of the upper and the lower side of the leaves, which are moreover of larger size, in the paniculated inflorescence, more angular anthers not opening at a distance from the summit, and dilated stigma.

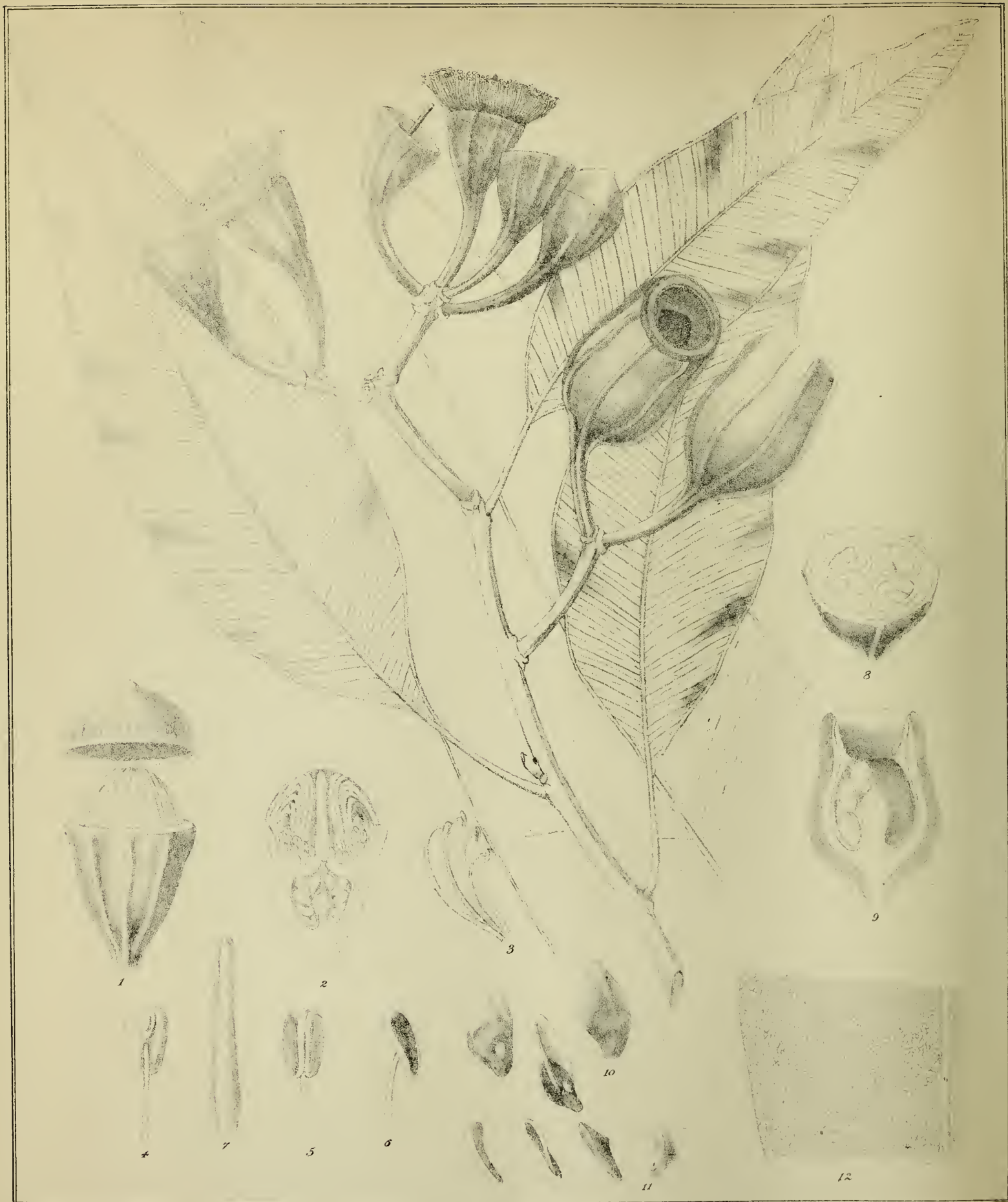
E. crebra and *E. microcorys* are also not dissimilar to *E. paniculata*, and mere fruiting sprigs of these three might easily be referred to the wrong species, but in a flowering state the mode of dehiscence of the anthers distinguish them easily from each other, irrespective of several other characteristics.

From the principal Ironbark-tree of New South Wales, namely *E. siderophloia*, we can best distinguish *E. paniculata* by the less deeply furrowed bark, by the frequent difference in the coloration of the leaf-pages, by the shorter calyx-lids, the sterility of the outer stamens, the infraction of all filaments while in bud, the terminal openings of the anthers, the dilated stigma and perfectly enclosed fruit-valves.

The twigs of *E. paniculata* are very lax and slender in either variety. The wood is very durable and extensively used by coachbuilders and wheelwrights; it is often darker than other kinds of Ironbark-timber, but not so tough as that of *E. siderophloia*. The calyces are generally of pale color. The filaments are almost white, finely capillary, and while in bud slightly flexuous, irrespective of being doubled back. The period of flowering seems a long one, at least that of the variety occurring in South Australia, where blooming panicles have been gathered from December till May; they are not much scented. The terminal pores of the anthers this species has in common with *E. Leucoxylon*, *E. melliodora* and *E. polyanthema*. The stigma is dilated, sometimes as much as that of *E. Leucoxylon*. The angularity of the calyx is hardly noticeable in the fresh flowers, but becomes obvious in dried specimens. By an oversight an error of the draftsman has been passed, who delineated the anthers as opening with longitudinal slits instead of terminal pores.

The Rev. Dr. Woolls found this Eucalypt flowering more regularly than many other congeners, and noted also, that it produced Kino in considerable quantity and that the bark is not so rugged as that of *E. Leucoxylon* var. *Sideroxylon*, but that the wood is easier worked than that of the latter.

EXPLANATION OF ANALYTIC DETAILS.—1, upper portion of an unexpanded flower, the lid lifted; 2, longitudinal section of an unexpanded flower; 3 and 4, front- and back-view of an anther with portion of its filament; 5, style and stigma; 6, some stamens in situ; 7 and 8, longitudinal sections of two fruits; 9, transverse section of a fruit; 10 and 11, sterile and fertile seeds; all magnified, but to various extent.



To H. del. C. Trondel & Co. Lith.

F. v. M. direct

Stearns. Litho. Co. Lith. & Col. M. J.

Eucalyptus ptychocarpa. F. v. M.

EUCALYPTUS PTYCHOCARPA.

F. v. M., in the Journal of the Proceedings of the Linnean Society iii. 90 (1858); Bentham, flora Australiensis iii. 255.

Finally rather tall; *leaves* large, scattered, from broad-oval verging into an elongate-lanceolar form, straight or somewhat sickles shaped, *paler and dull-colored beneath*; *lateral veins subtle, numerous, almost transversely spreading*, the circumferential vein nearly contiguous to the margin of the leaf; oil-dots concealed or obliterated; umbels terminal, paniculated, with 3 to 7 *large flowers*; stalks almost cylindrical; stalklets angular; *calyces ridged by about 8 longitudinal prominent lines*, the tube almost bellshaped or topshaped, twice or thrice as long as the nearly hemispheric lid; stamens all fertile, *filaments scarlet*, inflexed before expansion; anthers oval, bursting with longitudinal slits; style rather thick; *fruits large, truncate-ellipsoid* and slightly urnshaped or bellshaped, 4-celled, longitudinally lined by about 8 ridges, the vertical margin not very broad, but suddenly and amply descending to the orifice; *valves deeply enclosed*; *the fertile seeds produced into a rather large terminal appendage*, the sterile seeds much narrower.

Along rocky rivulets and also on the margins of exsiccating watercourses towards the sources of the Wentworth-, Wickham- and Limen Bight-Rivers (F. v. M.); on Melville-Island (Fraser); near Port Essington (Gilbert); at the mouth of the Liverpool-River (B. Gulliver).

A middle-sized or rather large tree, with a *greyish wrinkled everywhere persistent somewhat fibrous bark*, thus fluctuating between the Stringybark- and the so-called Box-trees, though in cortical characters perhaps nearest to *E. hemiphloia* and *E. albens*; but the accurate histologic examination of these and numerous other species in reference to their bark remains hitherto incomplete, though such would reveal in all probability important characteristics not only for specific discrimination, but also perhaps for industrial applications. Leaves conspicuously stalked, not rarely a span long, occasionally exceeding even a foot in length; their margin narrowly recurved as in all species with only hypogenous stomata. Flowerstalks from $\frac{1}{2}$ to 2 inches long, the stalklets still more variable in length, as well as the calyces often covered with a whitish in age evanescent bloom. Anthers dorsifixed. Fruits lignous, 1 to 2 inches long. Valves horizontal, deltoid. Fertile seeds about 2 lines long, with an almost oval appendage extending additionally to 3 lines; the appendage of the sterile seeds very narrow.

The description could only be prepared from scanty material. Mr. B. Gulliver, who saw the tree during Captain Cadell's discovery-voyage to the coasts of Arnhem's Land, states the flowers (filaments) to be scarlet. If really they participate in the bright color of *E. miniata* and *E. phoenicea*, we should have an additional highly ornamental species to select for our arboreta even here far south, as the intratropical Eucalypts proved in my experience quite hardy, wherever the thermometer does not sink below zero longer than a few hours at a time. It is mainly for this reason, that attention is drawn to this species now, although it may perhaps also prove a quick growing timber-tree of value for moist tropical climes, in places where many of the extratropical Eucalypts do not prosper.

Its affinity is with *E. Abergiana* and *E. miniata*; from the former it can be distinguished by its longer leaves with a still paler lower page, by its also still larger flowers, which are provided with usually long stalklets (although Bentham describes the latter as occasionally also very short), and most particularly by the fruit longitudinally traversed by about eight narrow ridges.

From *E. miniata* it is far more distinct in its not scaly-friable bark, which does not separate from the main branches, in the leaves being not of a pale and dull-green on both sides, besides

EUCALYPTUS PTYCHOCARPA.

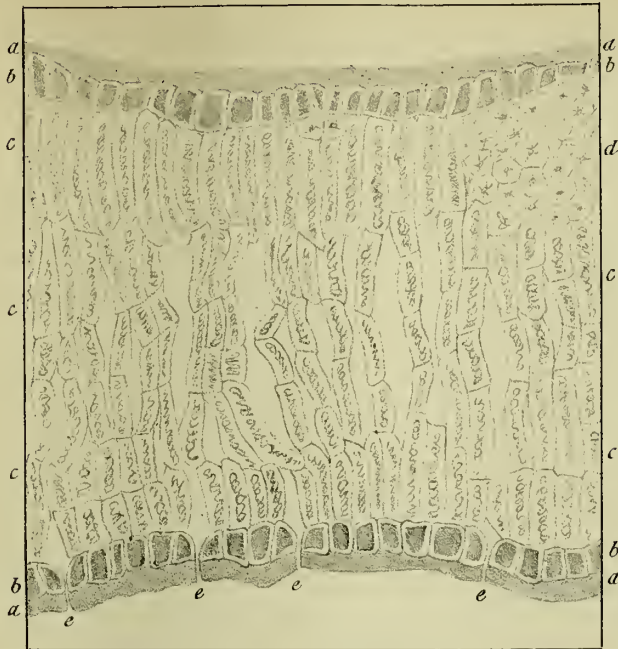
of thicker consistence, much larger and proportionately also broader, without any translucent oil-dots, in the absence of stomata on the upper page of the leaves ; further in the umbels not solitary nor lateral nor axillary, in larger flowers and conspicuous development of flower-stalklets, in fruits often smaller (although similarly shaped and ridged) and in the seeds provided with a long appendage (those of *E. miniata* being quite exappendiculate).

The alliance of *E. ptychocarpa* to *E. Watsoniana* is so much more remote, as to render a detailed exposition of their specific differences unnecessary. The leaves of *E. ptychocarpa* show on transverse section their chlorophyllous parenchyma-cells mostly in seven rows. The same numbers of series occur in *E. calophylla*, *E. corynocalyx*, *E. diversicolor* and *E. viminalis*, but in *E. globulus* these cells are stratified in eleven layers. Extended observations may however prove the numbers of the series, as above given, subject to some variation, but they may within certain limits be of diagnostic value. In the leaves of young seedlings of *E. viminalis* the number of cell-strata was found the same as in the leaves of aged trees, but the cells are smaller.

EXPLANATION OF ANALYTIC DETAILS.—1, unexpanded flower, the lid lifted ; 2, longitudinal section of an unexpanded flower ; 3, some stamens in situ ; 4, 5 and 6, back-, front- and side-view of an anther with portion of its filament ; 7, style and stigma ; 8 and 9, transverse and longitudinal section of a fruit ; 10 and 11, fertile and sterile seeds ; 12, portion of a leaf ; 1-7 and 10-12, variously magnified ; 8 and 9, natural size.

EXPLANATION OF LITHOGRAM OF EUCALYPTUS LEAVES, THE SECTIONS VERTICAL.—1, *Eucalyptus ptychocarpa* : *a*, cuticle ; *b*, epidermal cells ; *c*, parenchyma-cells in 5-7 rows, 7 prevailing, with chlorophyll ; *d*, grit-cells (sclerenchyma) ; *e*, breathing pores (stomata) on the lower side only.—2, *Eucalyptus calophylla* : *a*, cuticle ; *b*, epidermal cells ; *c*, parenchyma-cells in 6-7 rows, 7 prevailing, with chlorophyll ; *d*, grit-cells ; *e*, breathing pores on the lower side only ; *f*, oil-gland ; *g*, oleo-resin.—3, *Eucalyptus globulus* : *a*, cuticle, *b*, epidermal cells ; *c*, parenchyma-cells with chlorophyll in about 11 rows ; *e*, breathing pores (occurring on both sides, but the upper portion of the section omitted on account of the thickness of the leaf) ; *f* and *g*, oil-gland, containing oleo-resin.—4, *Eucalyptus viminalis* : *a*, cuticle ; *b*, epidermal cells ; *c*, parenchyma-cells, in 5-7 rows, 7 prevailing, with chlorophyll ; *d*, grit-cells ; *e*, breathing pores on both sides.—Augmentation in all these instances 214 times, diametrically measured.

1



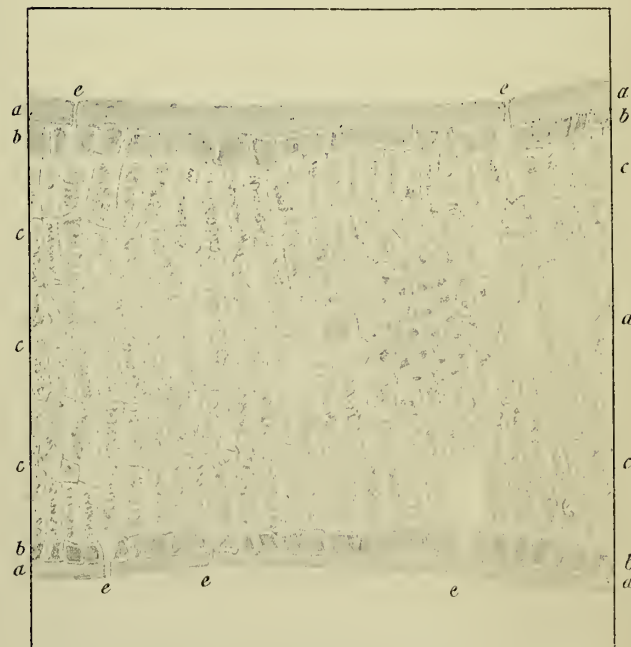
2



3



4



Eucalyptus leaves. *Transverse sections.*



Todt del. C. Troedel & Co. Lith.

F. v. M. direct.

Steam Litho. Gov. Printing Office. Melbourne.

Eucalyptus trachyphloia. F. v. M.

EUCALYPTUS TRACHYPHLOIA.

F. v. M., in the Journal of the Proceedings of the Linnean Society iii. 90 (1858); Bentham, flora Australiensis iii. 221; F. v. M., fragmenta phytographiæ Australiæ xi. 43.

Finally tall; *leaves* scattered, narrow- or elongate-lanceolar, slightly or sickleshaped-curved, rather *paler and not shining beneath, their lateral veins very subtle and numerous, feathery spreading*, the circumferential vein almost contiguous to the slightly recurved edge of the leaf, the oil-dots copious and translucent, sometimes much concealed; *umbels paniculated*, on slender stalks, with 8 or less very small flowers, the latter provided with thin stalklets of nearly the same or less length; *calyces* ovate-pearshaped before expansion, *tardily ruptured along the transverse somewhat irregular sutural line*; the lid depressed-hemispherical, not so broad as the tube and several times shorter; stamens all fertile; anthers ovate, somewhat truncated, bursting with parallel fissures; style very short; stigma but slightly dilated; *fruits rather small, urnshaped-ovate*, slender-stalked, smooth, 3- rarely 2-celled; their rim very narrow; valves deltashaped, deeply enclosed; seeds without any appendage, the sterile much smaller than the fertile seeds.

In poor hilly country, hitherto traced from Moreton-Bay (Bailey) to the Burnett-River (F. v. M.) and the MacKenzie-River (Bowman, O'Shanesy), chiefly in the sandstone-formation.

A tree, passing in colonial language as one of the Bloodwood-trees, attaining a height of 80 feet with a stem-diameter of 2 feet, but in exposed situations on the tops of hills dwarfed in growth and fruiting already in a shrubby state. Timber pale, flexuous in fibre. Bark persistent on the branches as well as on the stem, outside greyish-brown, irregularly fissurated and frustular, inside far more woody than fibrous, but not ponderous, pale-brownish. Leaves somewhat shining and darker above; stomata hypogenous only. Panicles terminal. Lid separating from the tube of the calyx not so much by a clear circumcision as by a fracture, thus often adhering on one point to the tube while the stamens are fully expanded, occasionally of only half the width of the tube, rarely somewhat pyramidal. Filaments white. Anthers dorsifixed. Fruit-calyces sometimes less contracted and then truncate-ovate. Seeds not very numerous, the fertile seeds in proportion to the capsular part of the fruit rather large, about 1 line long, ovate, plan-convex, fixed at the centre.

In this as in some other instances the definition of the species was elaborated from a very limited number of specimens; to give descriptions their fullest scope they should rest on examinations of trees instituted in the forests of many localities, for which purpose, as a rule, the opportunities arise only in the course of lengthened periods. Thus we are also unacquainted yet with the form of the seedling of this species.

The specific name of this tree was suggested by the roughness of the bark, conspicuous not less on the branches than on the stem. The timber seems not of leading value, but the tree is eligible, as mentioned by Mr. Bailey, for its shade in dry hot localities. More important in reference to its Kino, this species is pressed on our attention. The analysis of one sample gave us here as much as 73 per cent. of Kino-tannic acid (soluble in water and alcohol and precipitable by acetate of lead out of an acidified solution); 18½ per cent. Kino-red or allied substance (insoluble in water, but soluble in alcohol); 8½ per cent. gum and pigment (soluble in water and partly in alcohol, but not precipitable by acetate of lead).

The systematic position of the species is in the series of the Bloodwood-trees, to which *E. corymbosa*, *E. terminalis*, *E. Abergiana* and their allies belong, notwithstanding the smallness of its flowers, although in this and some other respects *E. trachyphloia* approaches *E. crebra* and



EUCALYPTUS TRACHYPHLOIA.

some cognate Ironbark-trees, all of which however have the stomata isogenous and show a clear line of dehiscence, by which the lid is separated, while the difference of the anthers separate them even sectionally according to Bentham's system. Besides in *E. crebra* the lid is not depressed, the fruit is not or less contracted at the summit, and the valves are almost terminal. Its real systematic place should be next to *E. dichromophloia*, from which it can be distinguished in rougher bark, in thinner less elongated leaves of a darker green above and dull paleness beneath (therefore not of equal color on both sides) with recurved edge, in the want of stomata on the upper page of the leaves, in the calyces of less polished smoothness, in smaller fruits with perhaps never or only rarely four valves, and in the absence of any appendage to the fertile seeds.

EXPLANATION OF ANALYTIC DETAILS.—1, unexpanded flower, the lid partly detached; 2, longitudinal section of an unexpanded flower; 3, some stamens in situ; 4, 5 and 6, front-, side- and back-view of an anther with portion of its filament; 7, style with stigma; 8, longitudinal section of a fruit; 9, transverse section of two fruits; 10 and 11, fertile and sterile seeds; 12, portion of a leaf; all magnified, but to various extent.

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CORYMBOSA, Smith.

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DIVERSICOLOR, F. v. M.

HEMIPHLOIA, F. v. M.

INCRASSATA, Labillardière.

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